See Back Cover!

POPULAR AVIATION

SEPTEMBER 25c
In Canada 30c

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See Page 182

Did NAZIS Shoot Transatlantic Flyers?

Gruesome Findings of P. A. Investigations on Page 142

HERMAN L. Ballin

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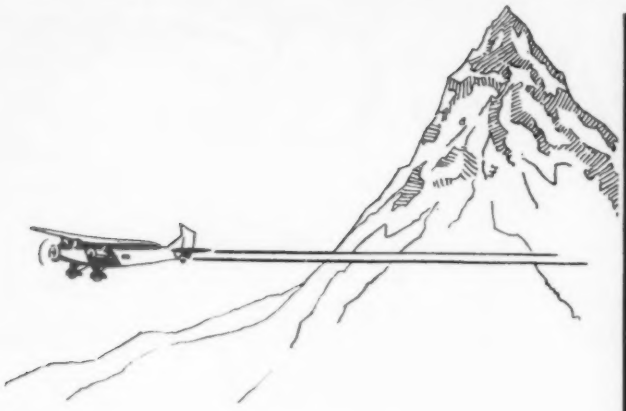

John H. Littley, now flying in the land of the Midnight Sun, one of 40 Parks graduates placed during the past 45 days

From ALASKA To PERU PARKS GRADUATES ARE MAKING GOOD

"Flying is certainly different up here," writes Parks graduate John H. Littley from Anchorage, Alaska. "I am writing this at eleven o'clock and the sun is just setting. The colors are beautiful, blues, yellows, reds and purples and every combination of those, with the mountains silhouetted against the sky. I have flown over some areas that are not even on the maps; just blank spaces. Since I have been up here I have averaged at least one charter trip a day, with either freight or passengers to such points as McGrath, Fairbanks, Ophir, Flat, etc." Littley left Parks on June 19 for Alaska, where he is making good in a big way.

A letter just received from Ernest W. Grey, who received his special training and his transport license in May, states, "Here I am away down in Lima, Peru, as co-pilot and radio operator for Pan American-Grace Airways. My application seems to have hit the company just right, for here I am."

Littley and Grey are only two of more than 40 Parks men who have accepted good jobs within the past 45 days.

Parks Air College has never guaranteed or promised a job to any student, but it is an inspiring thing to have aircraft executives call on us with increasing frequency for well trained men. Parks graduates are working for every leading airline and airplane manufacturer, and on the finest airports in America. If you are ambitious and will work hard, aviation is calling you. But remember your entire future depends upon *where* and *how* you are trained. Aviation has no room for the untrained or poorly trained man. So choose Parks Air College—largest in the world—the School of Champions. Send the coupon below for a free copy of our profusely illustrated catalog. It will give you complete information without obligating you in any way!

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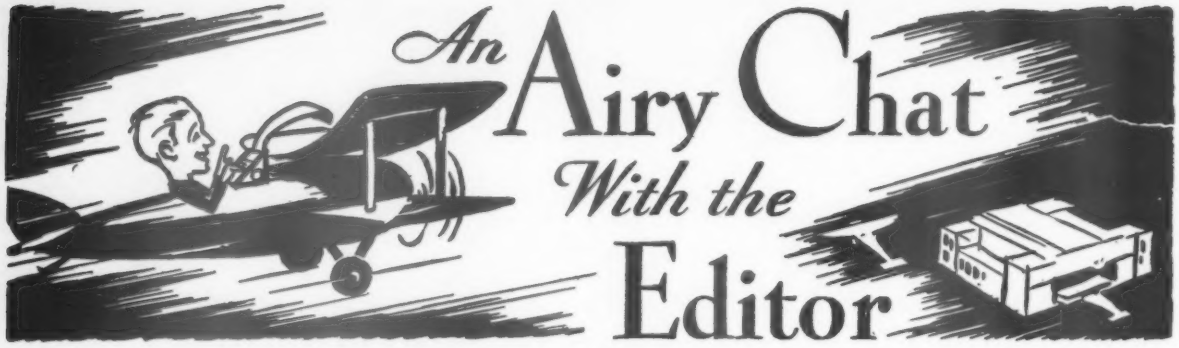

An Airy Chat With the Editor

THIS banner towing game is giving a lot of the boys a good job in these troublous times. Almost any place you can look in this town, you can see some sort of a banner being hauled along, calling your attention to various products ranging from beer to spark plugs.

Within the short space of five minutes, the writer has seen examples of banner towing by three different types of aerial vehicles: by an Autogiro flown by Lon Yancey, by two airplanes and by the Goodyear Baby Blimp. All three of them passed my window in rapid succession. But the blimp goes them all one better by carrying a huge neon sign along her side which can be read at a great distance in the evening. Good publicity, all of it, for the signs are read by the thousands attending the Century of Progress exhibition.

* * *

WE CARRY a most astounding revelation in this issue. The story of the ill-fated Lithuanian transatlantic flight that ended so tragically before the flyers reached their objective. We'll say no more about the matter here, but beg you to read the story itself which gives a thrilling account of the crash and the probable reason for it.

* * *

FAN-DANCE fans will be surprised to learn that the dean of all fan-dancers, Sally Rand, holds or held a transport pilot's license. In fact, Sally is an old hand at the flying game and travels everywhere by air to her numerous engagements.

* * *

TALKING about Lithuania calls to mind the second attempt that is being promoted. Unfortunately, complications have set into the project to the extent that this flight may be delayed for some time if not canceled altogether. As has been remarked many times in these columns, it takes more real ability to organize and finance a transatlantic hop than to actually make the hop itself.

* * *

THIS year, the Century of Progress has very little to offer in the way of aircraft exhibits, that is, historical exhibits or exhibits by manufacturers. The government exhibit is about all there is worth mentioning and even that is condensed and restricted. Seems strange, doesn't it, that a great world's fair, intended to reflect the progress in science and invention during the past century, should omit an extensive display of the most noteworthy development in engineering during that time —the airplane.

* * *

BUT, in spite of its shortcomings, the Century of Progress has brought to us many worth while pleasures. The greatest of all pleasures, be it said, is the opportunity of meeting many of our readers that the fair has brought into Chicago. Friends from the south, north, east and west have visited our office during the summer, and it is a great satisfaction to note the high regard in which these men hold POPULAR AVIATION. They went to a lot of trouble to hunt us up and drop a cheery word of appreciation that will live for a long time in our memories.

* * *

A NEW color scheme has been adopted by the Department of Commerce for the Department's planes. It is a combination of black and orange which is a striking color scheme that has many practical advantages. With this important matter set at rest, wonder how soon the Department will take up the amateurs' cause and introduce a note of liberty into American amateur aviation?

* * *

BUT we must give the Department its just dues. It has considerably reduced the burden on the private pilot who now has more real liberty than many of the other ratings. In fact, many of the old-timers holding transport tickets who have visited us recently say, that if they were not flying for a living they'd drop back into the private class because this lower rating has so many distinct advantages.

* * *

THE other day, the old argument on the subject of wing-slots, their advantages and disadvantages, was dug up and exposed to the sun's rays. But, out of the pilots present, not one of them cared to provide their ships with slots even though the slots were installed free of charge. It seems strange that there should be such a difference between this country and England on this subject because it should be a simple matter to decide once and for all whether the slots have any real advantage.

* * *

SUMMED up, the main difficulty with the slots seems to be their uncertain behavior under abnormal flying conditions. Under normal conditions—fine—but in steep dives, as in making a forced landing, the slots seem to fight the attempts of the pilot at sitting her down and this very greatly increases the tendency toward overshooting the field. We'd like to hear some more on this subject from pilots who have had a considerable amount of experience with flaps and slots.

* * *

IT SEEMS as if everyone was engaged in writing aviation stories lately, we've had such a volume of manuscript presented at this office. Everyone who has a typewriter, a fountain pen, pencil or rusty nail at hand has budded out into aviation authorship. It's a heck of a job to read all of this mss. carefully, but we're more than willing if the authors will be a little patient. Some of it is good dope.

* * *

WHAT does a parachute jumper think about on his way down? This question is answered in an entertaining manner by one of America's best known exhibition jumpers in this issue. His original title for his story read, "250 Miles Down," and this just about describes the matter for he estimates that he has descended vertically all this distance since he first walked out of a plane into thin air.

* * *

WE ARE in receipt of a letter from Lieutenant H. B. Miller, U. S. N., attached to the U. S. S. Macon, that will be of great interest to our Photo Phans. He writes:

As Senior Aviator of the Heavier-Than-Air Unit attached to the U. S. S. Macon, I must confess my admiration for the excellent painting of the F9C-2 airplane which appeared on the upper portion of the back page of your July, 1934, issue.

I wonder if it is possible for my Unit to secure the original of this illustration for use in decorating our office? Possibly, you loan these paintings for suitable display. At any

(*Concluded on page* 201)

POPULAR AVIATION

Including SOUTHERN AVIATION and AERONAUTICS

A MAGAZINE FOR THE PROMOTION OF AMATEUR AVIATION AND PRIVATE FLYING

Volume XV SEPTEMBER, 1934 Number 3

NRA U.S. CODE

TABLE OF CONTENTS

FEATURE ARTICLES

AN AIRY CHAT WITH THE EDITOR 140
DID NAZIS SHOOT DOWN YANK TRANSATLANTIC FLYERS? 142
SIKORSKY AND HIS GIANT PLANES 145
THE BIRTH OF THE AIRSHIP 147
250 MILES IN A PARACHUTE 149
AMERICAN WARPLANES IN CHINA 151
LETTERS FROM OUR READERS 153
ON THE OUTSIDE LOOKING IN 155
THE AERO-SPORTSWOMAN 156
1934 ADDITIONS TO THE WACO LINE 157
KEITH RIDER IS ATTEMPTING A SUPER-SPEED OF 465 M.P.H. 159
AN AVIATION ENGINE QUIZ 160
AN IMPROVED COURSE INDICATOR 161
PROPERTIES OF AVIATION GAS 163
A FEW SIDELIGHTS ON AVIATION 165
KINNER'S FOLDING-WING PLANE 167
WHAT ABOUT THE SPAN-LOADING? 169
THE CAPRONI SCHOOL BOMBER 171
BUILDING THE EPPS LIGHTPLANE 172
WHAT OUR READERS ARE BUILDING 175
P. A.'s KONTACT KLUB KOLUMN 176
BUILDING THE SEVERSKY 3-L 177
WHAT THE INDUSTRY IS DOING 183
RECENT PATENTS IN AVIATION 184

PICK OF THE BRIEFS

A New Low-Wing Sport-Plane 146
Here's the Martin Bomber in Flight 152
Airplanes Stored on Movable Trucks 154
Flaw Detection 154
Tetrachlorid Fumes 154
Glossary of Words, Terms and Phrases 160
Stainless Steel Ship Shows Long Service 164
The Clawson Kite-Plane Flies Well 166
I.E.S. Discusses Future of Aviation 166
Wiley Post's Airtight Suit 168
A Japanese Reader's Dream-Ship 168
P. A. Data Sheets 170
Flying Wing and the Vortex Theory 170
P. A. Data Sheets 176
The Sversky 3-L Landplane 182
Floyd Kalak Takes Trip 182

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Did Nazis Shoot Down

Did blood-mad Nazis relentlessly shoot down the Lithuanian flyers, Darius and Girenas, almost at the completion of their magnificent trans-Atlantic flight? Officially no, but the present habits of international intrigue, artful maneuvering and national whitewashing within the circles of international politics, makes it impossible to accept official statements when there is so much seeming evidence and rumor to the contrary. Examine the history of the flight, read the suspicious circumstances reported, the facts obtained in interviews with the family of Darius, those connected intimately with the flight, the official statements of the case, and judge.

Landing in a dense forest as it did, the Lithuanica was torn into pieces with the wreckage spread far and wide about the scene of the dramatic crash.

by

E. STANTON BROWN
Staff investigator for
POPULAR AVIATION

AT 5:24 A. M. on July 15, 1933, the Bellanca monoplane "Lithuanica" lifted heavily from Roosevelt Field, New York City, and pointed its nose to the northeast. Captain Stephen Darius and Lieutenant Stanley Girenas settled themselves for the strenuous flight before them.

Experienced flyers both. Ex-doughboys who had valiantly struggled and bled for Uncle Sam in the muck and slime of the battlefields of France. American citizens blazing a new path of glory through the skies.

As true as a homing pigeon, the "Lithuanica" thundered through the skies toward Kaunas, the capital of Lithuania. New York—Ragged Harbor, Newfoundland—the Atlantic—Ireland—London—the European Continent. At no time more than ten miles off the true course. Such did the logbook show, attesting to the superb airmanship and navigating skill of the daring flyers.

July 17, 1933. A terse statement from the Associated Press. "Soldin, Pomerania, Germany — The airplane 'Lithuanica,' in which Stephen Darius and Stanley Girenas were attempting a non-stop flight from New York to Kaunas, Lithuania, crashed early today at Kuhdamm and both flyers were killed. Kuhdamm is five miles south of Soldin."

Grief blanketed Lithuania. The sympathy of the world was extended to the staunch little Baltic republic, to those in America who had sponsored the flight and to the bereaved families. Lithuania, who had eagerly awaited the successful landing of the flyers, somberly awaited their dead bodies.

Then ugly rumblings were heard. The circumstances concerning the crash were suspicious. The so-called investigations into the cause of the crash held conflicting statements. By the time the representatives of the Lithuanian government arrived, all wreckage had been cleared away and little more than half the plane remained. An aviation captain of Lithuania, after investigating at Soldin, to which the bodies and wreckage had been taken, refrained from making an announcement of his findings because of the startling nature of what he discovered. The official statement of Nazi Germany did not dovetail with known facts. Haste and secrecy clouded the issue.

Uproar! What caused the crash? What lay behind the tragedy and the secrecy attending it? For forty-five hundred miles the ship had proved faithful. Why should it fail but four hundred miles short of the goal and over territory with which Darius was completely familiar, having flown over it before? It was recalled that two other planes, one from Latvia and one from Poland, had crashed mysteriously in the same area some time before. A ten-mile circle could enclose the scenes of the three crashes!

British, French, Belgian, Polish,

THIS article appears largely by the request and insistence of many of our readers who have taken a great personal interest in the fate of the two daring flyers.

A P. A. reader, "J. B." of Great Neck, N. Y., writes us a letter in which he states: "I ask that POPULAR AVIATION could publish a little story for those two daring flyers, Stephen Darius and Stanley Girenas, who were killed in Germany. (It was no accident either.) This flight meant a lot to the Lithuanians, even though Lithuania is a small and powerless nation. She tries her best to be recognized by the world.*

"I assure you that these flyers were not killed by accident or shortage of gas, they were actually murdered, shot down by the Germans. This seems as though it is not fair to accuse the Germans for these flyers' deaths, but when bullets were recovered from these flyers, it is evidence enough."

In a second letter, "J. B." writes: ". . . I know that information about their crash will be hard to get, because Lithuania will not dare accuse Germany of having anything to do with the death of these two flyers.

"It is evident enough that Germany was afraid of something, because when Lithuanian officials arrived, the two flyers were already removed from the scene and the wreckage was piled up in one heap."

**We do not give his full name simply to protect him and his family against reprisals.*

Не атмосферныя условія и не отсутствіе бензина.

(По телефону отъ каунасскаго корреспондента „Сегодня".)

Каунасъ, 15 іюля. Товарищъ прокурора каунасскаго окружнаго суда Книготь | вероломъ Дерлуфта, на который и были установлены гробы.

Свалка между матросами англійскаго крейсера

A reproduction of the headline in a Russian newspaper which rufutes the official German statement that lack of gasoline forced the flyers down. Translated, this reads: "Neither Weather Nor Lack of Gasoline the Cause of the Tragedy!"

Yank Transatlantic Flyers?

(Translated from "Lietuvos Zinios," Prominent Lithuanian Newspaper, Rugpjucio, 23, 1933.)

"WHAT SOCIAL-DEMOCRATS OF GERMANY SAY ABOUT DARIUS AND GIRENAS

"THE German newspaper, 'Neuer Vorwaerts' No. 10, carries the headlines saying that the Lithuanian flyers were shot down by the SA near Soldin.

"The Germans claim that lack of gasoline caused the death of the two flyers. For this reason they sought a place to stop, and flew at midnight through Soldin at 100 meters height over the town, where are located the concentration points. The guards of the concentration camps thought them to be the airships of the enemies of the state carrying propaganda, and began to shoot at the planes, from the machine guns.

"The first news from Soldin also were of the same nature. But the first government news, which came out the following morning, called the happening an accident. The doctors and all those who were at the airports, were instructed to conceal all clues of the crime. But since the people did not cease talking of the flyers, the government issued a statement saying that it was absurd that the flyers were dragged down by the "Death ray." But in reality, they were not brought down by the "death ray," but only by the machine guns of the Germans."

Darius bidding his mother a last farewell just before taking off on his last tragic flight. It is this mother that is the real victim of the tragedy.

Czechoslovakian, as well as Lithuanian, newspapers screamed with the astounding statements that the flyers had been outrageously shot down! It was not inconceivable. Life is held cheaply in Nazi Germany, as evidenced by the recent unwarranted wholesale slaughter of hundreds of human beings under the direction of the fanatic Hitler and the blood-thirsty Goering, who was once an inmate of an insane asylum.

Suddenly the press was quiet with only an occasional daring outburst. The lid had been clamped on. It became a bit dangerous to refer to the tragedy as other than purely accidental. The alleged shooting was cause for war. Consequently, Lithuania walked warily, not wishing to incite the larger and more powerful nation. But glaring facts which demanded answering and explanation remained ignored and unexplained. The people growled and demanded the truth amongst themselves, but officially the tragedy was a closed incident.

The family of Darius requested our State Department to render the dead flyers their constitutional rights as citizens of the United States and determine the true cause of the tragedy. The State Department replied that "it was an unfortunate accident." In official circles here and abroad, the subject is received with shoulder shrugging, enigmatic smiles. Ignorance is professed. "Yes, we would like to know the truth, but it is a mystery." Officials of governments have expressed their opinions through the press to the effect that the flyers were shot down, but their names are withheld. And so the tragedy of the Lithuanica seemed doomed to remain "The Secret of Soldin Forest," held fast by fearful people who are afraid to talk.

Scraps of fabric torn from the fuselage of the Lithuanica after the crash.

POPULAR AVIATION, in the name of sportsmanship and justice, has taken up the investigation. The facts and evidence collected are here set down. What is stated here has, in most instances, never been released by the American press. Why, we would like to know, have the conflicting reports, the rumors which seem to have basis, the suspicious circumstances of the crash which shriek aloud for investigation, been kept from the American people?

It is well known that Darius, in planning his original route across the ocean to Lithuania, intended to fly over the southern end of the Scandinavian peninsula to avoid going over Germany. People who knew him well stated that on several occasions he said that his chances of completing the flight would be much greater if he did not fly over Germany. Why did he change his original plans? Of what was he suspicious?

The answer to the first question is that going by way of Ireland, England and over Germany he would have less over water flying to do and would have a better chance to check his navigation. As to the second question, the facts

speak all too eloquently of why his last-minute change of plans proved fatal to him and his flying companion.

On the night of the tragedy, a storm had settled in the north central part of Europe. At 10 o'clock on the night of July 16th, the "Lithuanica" appeared over Koenigsberg in the province of Pomerania. Rockets were sent up and then the plane disappeared in a westerly direction. About midnight the plane appeared over the town of Berlinchen, 120 miles northeast of Berlin and circled at an altitude of about 200 feet. It appeared twice over a voluntary labor camp.

Reports conflict as to whether they dropped a flare from the plane or the guards turned searchlights upon the "Lithuanica." It has been definitely stated, however, that the flyers were seen leaning from the cockpit of the plane. *Later, the guards of the camp stated that they thought the plane was Polish, an "enemy" plane attempting to make a photographic survey of the camp.* Berlinchen is very close to the troubled Polish frontier, as is also Soldin. The plane flew away in a southwesterly direction. *What happened before it flew away?*

About 12:30 A. M., a farmer near Kudhamm, on the edge of the Soldin forest, heard a plane come out of the northwest. Soon after he heard a violent crash. Since it was raining, he didn't investigate. The next morning, the wreck of the "Lithuanica" was found in Soldin forest by a peasant woman and her daughter hunting mushrooms. The mail bag had been dropped from the ship some time before the crash. The dropping of the mail bag proves that they expected to crash. *What is the basis of the rumor that a bloody handkerchief was found in the mail bag?*

From the finding of the crash, the course of events ran in a very questionable manner. All evidence of the tragedy was hastily removed before the Lithuanian officials arrived to investigate. The bodies were taken to Soldin and placed under a guard of six Nazi Storm Troopers. They were hurriedly placed in coffins and the coffins soldered shut. Such was the hurry that three hands were reported found in one coffin when opened in Kaunas.

The wings of the plane disappeared completely. Storm Troopers broke off parts of the plane and took them away, as did the people of Soldin. The wreck was taken to Soldin and sealed in a box car. When the Lithuanian government discovered that little more than half of the plane remained, they demanded the return of the stolen parts. The Nazis promised that everything would be returned. In the end, though some parts were returned, only about two-thirds of the ship was recovered. *Why was the rest of the ship not returned?*

Darius and Girenas (left) in the Lituanica. This picture is a reproduction of a souvenir photograph taken some time before the flight.

The first official Nazi statement was to the effect that the flyers ran out of gas and were forced down in the forest. *Those who reached the crash first, and the first reports from Soldin, stated that there were at least fifty liters of gas in the tanks and ten liters in a reserve tin.* Investigation of the wreckage of the motor determined that motor failure was not the cause of the crash. Expert opinion was to the effect that the weather could not be responsible.

Evidence at the scene of the crash proved that the ship had been flown into the tree tops with its motor running at cruising speed at least. For a hundred yards the tops of the trees were cut off, large trees were bowled

(*Continued on page* 185)

„Lituanica" pašauta nebuvo

Pareiškė inž. K. Bulota

Lenkų, rusų, belgų, prancūzų ir kitų prasimanymai. Benzino bakai išmesti į okeaną. „Lituanicoje" nerasta nė vienos peršautos skylės. Dariaus ir Girėno kūnuose jokių kulipkų nerasta. Tikroji „Lituanicos" katastrofos priežastis.

Po įvykusios tragedijos su mūsų transatlantiniais lakūnais užsienio spauda ypač dinių turėdavo perpilti benziną į didelius tankus ėsančius lėktuve, o nereikalingas prasta fantazija, kokią tiktai galima sau įsivaizduoti. Tai galiu tvirtinti, nes jau yra transatlantiniai lakūnai Darius ir Girėnas skrisdami per Soldiną tikrai notėję nusi-

Reproduced from a Lithuanian newspaper. Translated, the large upper headline reads: "What Other Newspapers say about the Lituanica." The lower subhead says: "Latvian, Russian, Belgian and Polish Newspapers say the flyers were shot down."

Sikorsky and His Giant Planes

by ROBERT H. RANKINE

Ivor Sikorsky, specialist in the design of mastodonic airplanes and pioneer in aviation, has always been an interesting and commanding figure in aeronautics. Mr. Rankine outlines the more important of his achievements.

TO ANYONE familiar with aviation, the name Sikorsky calls to mind the successful engineering of multi-motored aircraft.

Indeed, it would be quite difficult to find in the field of aeronautical engineering a man whose training and experience is more varied and extensive than that of Igor Sikorsky. Step by step, since the time he designed and constructed the first successful multi-motored aeroplane ever flown, Mr. Sikorsky has been a leader in the development of big planes.

Igor I. Sikorsky was born in Kiev, Russia, in the year 1889. During his childhood he evidenced an interest in mechanics and as a small boy he built mechanical toys which were extremely ingenious for a lad of his age. After finishing the course at the Kiev High School he entered the Navy College at Petrograd.

Graduating in the General Course from this institution, he went to Paris, where he studied mathematics, chemistry and drafting. Returning to Kiev, he entered the Mechanical College of the Polytechnic Institute.

In 1908, at the age of 19, Mr. Sikorsky began his work in aviation. His first machine was a helicopter, powered with a 25 h.p. motor. This machine supplied much interesting and valuable data for future study, and in 1910 a second helicopter was built.

This machine was equipped with two propellers, turning in opposite directions. It could lift its own weight but it did not have sufficient power to lift the pilot. In this same year, the first Sikorsky airplane was built. This plane, the S-I, was powered with a motor of 15 h.p. and could rise from the ground if headed into a wind.

At the end of the year, two more machines were completed. The S-2, powered with a 25 h.p. motor which made a flight of 600 feet; and the S-3, Anzani 40 h.p. motored, which made a flight of 59 seconds. In 1911, the S-4 and S-5 with a 60 h.p. motor gave very good results.

The S-5, piloted by the designer, made several flights of up to an hour's duration and reached an altitude of 1500 feet. The next plane developed, the S-6-A, received the highest award at the Moscow Aviation Exhibition in 1912, and in the fall of the same year, the S-6-B, piloted by Sikorsky, won the first prize in the Military Competition at Petrograd. It is interesting to note that among the competing planes were such well-known makes as Farman, Nieuport and Fokker.

As early as 1911, Mr. Sikorsky decided that the future of aviation depended upon the success of large multi-motored planes and in the spring of 1913 he built the first airplane of that kind in the world. This airplane was equipped with four 100 h.p. engines. The gross weight of the machine, when loaded, was 10,340 lbs., or 25.8 lbs. per h.p.

In 1913, two of the Sikorsky ships received first and second prizes in the Russian Military Competition and in June, 1914, the designer made a flight to Petrograd and return, from Kiev (a distance of some 1600 miles). This was quite a long flight for that period.

Using every new scientific method,

Ivor Sikorsky, the Russian genius in aeronautical engineering.

and with his unique experience, Mr. Sikorsky constructed a series of large multi-motored planes. The last machine built by him in Russia, in 1916, had a gross weight when loaded of 17,000 lbs. and a lifting capacity of 6,000 lbs. useful load. This plane was equipped with four Renault motors of 220 h.p. each. These motors were the same weight as the 400 h.p. Liberty motors.

During the World War, from 1914 to 1917, seventy-three large Sikorsky planes were delivered to the Russian Army and these planes made the first heavy aerial bombardments. It is significant that, in more than 400 flights over enemy territory, only one ship failed to return to its headquarters. This machine was brought down by pursuit planes which attacked her in great numbers.

Following the unhappy events of 1917 in Russia, Mr. Sikorsky went to France at the invitation of the French government. He was commissioned to construct his type of airplane according to French military specifications. This work was to have been started in October, 1918, but it was terminated by the armistice. At the conclusion of the war, he came to the United States where he at once gained recognition as a designer.

In 1923, the Sikorsky Aero Engineering Corporation was formed and in the fall of 1924 this concern completed the S-29. This was a fourteen passenger cabin landplane and, being one of the first large passenger planes built in this country, it attracted wide attention.

In 1925, the business of the Sikorsky Aero Engineering Corporation was taken over by the newly formed Sikorsky Manufacturing Corporation. The following types of planes were built by these two companies:

Type S-31 — Five seater plane equipped with one Wright J-4 200 h.p. air-cooled engine.

Type S-32 — Five seater equipped with Liberty 400 h.p. motor.

Type S-33 — Two seater equipped with Lawrence 60 h.p. air-cooled engine.

Type S-35 — Tri-motored plane equipped with three Jupiter 400 h.p. air-cooled engines. This plane was built for the flight of Captain Rene Fonck, the French ace, from New York to Paris. The plane met with disaster on its attempted take-off for Paris.

In 1926, the quarters of the Sikorsky concern were moved from Roosevelt Field, Long Island, to College Point, Long Island. During 1927 the following planes were designed and built:

Type S-36—Eight seater amphibian plane equipped with two Wright J-5 engines.

Type S-37—Eighteen passenger land cabin plane equipped with two 400 h.p. air-cooled engines.

Type S-37-B—A night bombardment plane for the U. S. Army, equipped with two Pratt & Whitney 525 h.p. motors.

By the fall of 1927 the Sikorsky Company had developed an entirely new model of amphibian plane, namely, the S-38. This ship was powered with two Pratt & Whitney 400 h.p. Wasp engines and had a seating capacity of from ten to twelve passengers.

Under Mr. Sikorsky's leadership, the engineering department of the company developed a unique method of

metal construction. This method provides a construction of open duraluminum extruded sections. The construction is unusual, since welding is entirely avoided. The open sections are riveted and bolted together, just as in steel structures such as bridges and skyscrapers.

Prior to this, Mr. Sikorsky devised a special design of rudder which insures a perfect stability of flight direction. This enables the pilot to stop any side motor at will for repairs or inspection without endangering the flight. The safety factor which this provides is at once apparent.

In 1928, the Sikorsky Aviation Corporation was formed and a program of 100 ships of the S-38 type was scheduled. These planes were sold to the Army, Navy, commercial airlines and private owners. The Pan American Airways started their operations between North, South and Central America, choosing the S-38 as the nucleus of their equipment. During this same year the company completed a new factory at Bridgeport, Connecticut, for the old plant at College Point, Long Island, was too small for further engineering development and production of the existing types. This new factory has a floor space of 225,000 sq. ft. and is provided with excellent modern equipment and laboratories for aerodynamic and structural research.

The year 1930 saw an S-38 type amphibian converted into a seaplane which established the following World and U. S. records:

Altitude with 1,000 kilograms payload—March 13, 1930, 23,222 feet; July 21, 1930, 26,929 feet.

Altitude with 2,000 kilograms payload—March 4, 1930, 19,065 feet; Aug. 11, 1930, 19,928 feet.

Speed for 100 kilometers with 2,000 kilograms payload — March 13, 1930, 143.77 miles per hour.

All records were established by Captain Boris Sergievsky. In the same year the following planes were developed and built:

Type S-39—Five passenger amphibian, powered with a 300 h.p. Wasp Jr. engine.

Type S-41—Fifteen passenger amphibian, powered with two 575 h.p. Pratt & Whitney Hornet engines. This plane was designed as a link between the S-38 and the S-40.

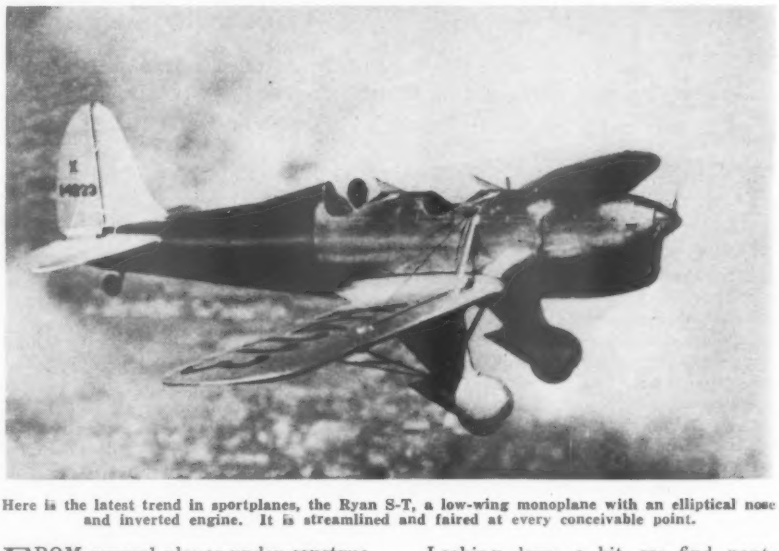
Type S-40—Forty passenger amphibian, powered with four Pratt & Whitney 575 h.p. Hornet engines.

Type S-42—Flying Boat, at present undergoing flight tests, no data available for publication.

The design of the S-40 was started in the Fall of 1929, and the first experimental plane was delivered to the Pan American Airways in October 1931. It is the largest amphibian operated on scheduled mail and passenger service. The gross weight of the S-40 is 34,000 lbs. of which 13,000 lbs.

(*Concluded on page* 193)

A New Low-Wing Sportplane Arrives



Here is the latest trend in sportplanes, the Ryan S-T, a low-wing monoplane with an elliptical nose and inverted engine. It is streamlined and faired at every conceivable point.

FROM several planes under construction at the present time it would seem that the radial air-cooled engine is being challenged for supremacy by the inverted air-cooled type, at least in the sportplane field.

The Ryan S-T sportplane shown above is one of the latest in this trend and is said to show an outstanding performance. It would seem that Heinkel left a lasting impression on the designer, for starting with the sharp bullet nose, the fuselage is typically Heinkel. And yet, the bullet nose also suggests recent British practice in respect to the installation of the inverted engine.

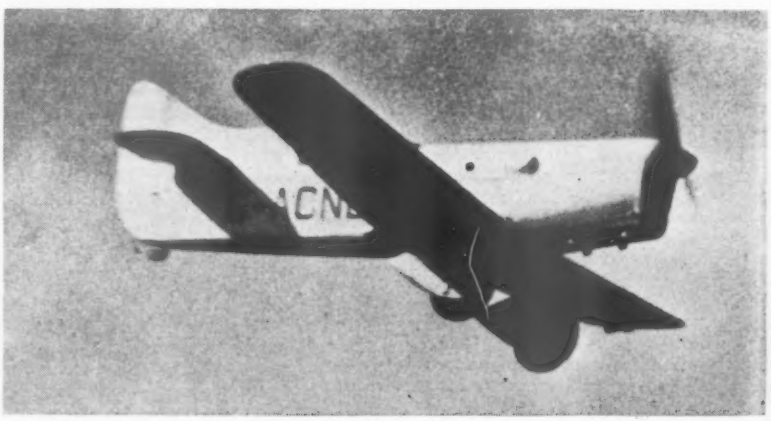
Looking down a bit, we find pants and spats that look as if they might have been abstracted from a Gee-Bee. From this point on, however, the designer has been content to introduce his own structural ideas in respect to the exterior bracing. If fuel economy and speed are the great factors in aviation, then this design should meet with great applause in the United States.

And another point, we find more and more monoplanes with externally braced wings and wire cable braced wings at that. Struts are out and wires are in once more. Maybe we'll go way back to the pre-war monoplanes.

The Percival Mail Plane is Fast

HERE we see the new British mail-plane, the "Percival," in flight, which in many ways reminds us strongly of the Gee-Bee and the several planes in that school of design.

It is a single-seater low-wing monoplane with a totally enclosed cabin and has a high speed of 202 m.p.h. with a range of 600 miles. Mr. E. Percival, the designer, has placed the wing well back which, with the rear position of the cockpit, gives the ship an unusual appearance. It is said to be the first British mail-plane to exceed 200 m.p.h.



A view of the English Percival mailplane in flight. Note certain similarities to the Gee-Bee and the peculiar position of the wing which is located about the midpoint of the fuselage.

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The dirigible,

The Birth of the Airship

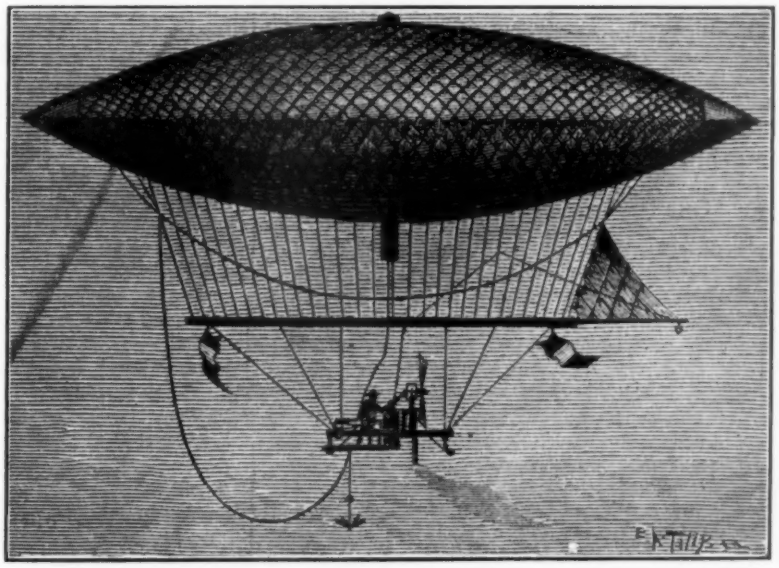
by ALVIN EDWARD MOORE
Examiner in the U. S. Patent Office

Mr. Moore, who has conducted an extensive research in airships, presents an interesting and authentic account of early adventures in the construction of powered lighter-than-air craft.

IN 1793, during the wars of the French Revolution, a young general of the French Army Engineers fell in battle. His name was Meusnier; he was only thirty-nine years old. When the King of Prussia heard of his death, he ordered his army, in honor of his service to mankind, to cease firing until the young general was buried.

Thus perished one of the great and generous minds in the long and glamorous history of the dirigible balloon. Meusnier was the first to propose cylindrical balloons with a bow and stern, ballonets to take the place of ballast, a triangular suspension of the balloon car, girths sewn around the envelope in lieu of a net (to which the lifting cords were attached) and permanent hangars. He was a leading exponent of the dirigible balloon in the days when the free balloon was in its infancy.

The author's experience in research in the patent-literature of the world has led him to the conclusion that basic industrial evolution always goes forward in three movements. First come the dreamers. Long before slowly moving man is ready for a certain improvement in his mechanical means of aiding his five senses, dreamers begin to glimpse as through a dark glass, the coming need. If wise in the ways of the world, these dreamers will not expect their visions to appear in concrete form in time to compensate them in a monetary way. If wise, they will talk and write of their dreams freely but only as a means of entertaining their friends and their people by their imaginations.



A reproduction of an early woodcut showing the first powered aircraft to be driven through the air. This is the steam propelled dirigible build by Henri Giffard which flew over Paris in 1852.

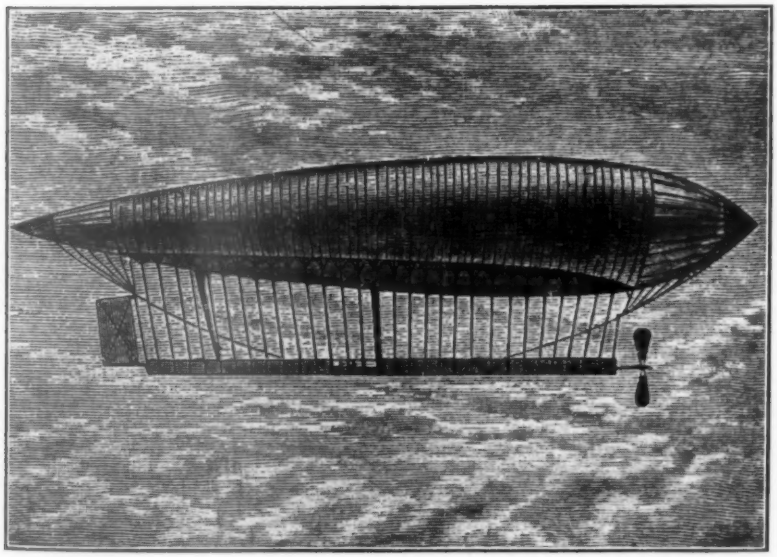
Jules Verne was an outstanding example of such a dreamer, called a visionary for a while and a practical world benefactor as time went on. Dreamers of space ships are present examples. Edison is the luckiest of the dreamers in the world's history—lucky because he was both a dreamer and practical builder in a time when the industrial world was moving fast.

After the dreamers come the first practical builders. They usually fail of final success. They take the dreams of the others, sift them, analyze them, exert on the final product their own fertile but not so broad imaginations and one or a group of them come forth after many trials—and often heartbreaking defeats—with a winning solution of the problem of mankind. The Wright Brothers of the airplane and McCormick of the reaper were of this type of inventors.

Then comes the age of intensified development of the new machine. Engineers and inventors of small improvements, usually working little by little, improve it. In this age the new device allies itself with other arts, exchanging improvements with them. The dirigible balloon, in common with all other developed machines, has passed through these stages. It is now in its third stage and in the opinion of the author, will go from this into a new infant stage—that of the rigid space-ship.

Meusnier was representative of the early dreamers of the dirigible balloon. With him are grouped Cayley and Mason of England and Jullien of France.

Cayley, known as the father of British aeronautics, with a mind akin to Meusnier, was the first to suggest the streamlined of dirigible. He did this in 1816—just after the War of 1812



The dirigible, "La France" of the year 1884. This was the first practical airship to show modern ideas of true streamline form.

of the United States—one hundred and seventeen years before the streamlined railroad train and automobile.

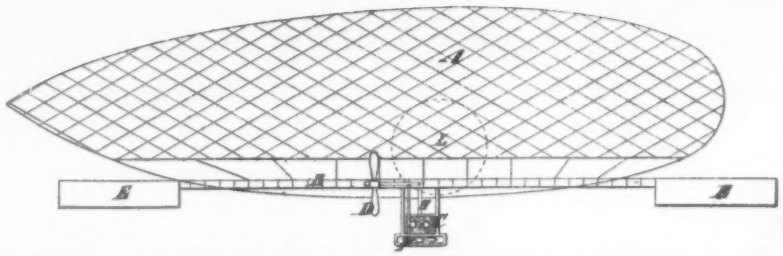
Cayley was also the first with the idea of making the balloon as large as possible to increase the proportion of its pay load and to make gas-tight compartments in the gas bag so if one was punctured the others still would hold gas; the first to suggest a rigid dirigible, with braces of small poles and wire or cord and one of the first to propose the installation of the newly-created Watt-type of steam engine in a dirigible balloon. Here we have a pioneer thinker of the dirigible on a par with his earlier comrade, the young Meusnier. Both had analytical minds and fertile imaginations.

The next significant dreamer after Cayley was Monck Mason, an ex-flute player, one of the first historians on aeronautics and an experienced pilot of free balloons. Even while he worked at his experiments of trying to devise a means of propelling a balloon, he saw there was little hope for his ever solving the problem. Nevertheless, he continued to do his best and he went down in that history which he himself helped to write as the maker of the first model power-driven airship. It was egg-shaped, weighed 20 pounds, and was driven by an Archimedean screw propeller, actuated by a spring motor.

The news of the success of this model, which in 1843 flew at six miles an hour in London, inspired that strange scientific and artistic American genius, Edgar Allan Poe, to write his story, "The Great Balloon Hoax."

Mason's success also inspired Pierre Jullien, a humble French clockmaker, to embody his ideas in a model which he named "The Precursor." It was a streamlined cylinder, equipped with both vertical and horizontal rudders, with a spring motor-operating side propellers. Untold millions of years after nature had designed the fish, man thus designed its streamlined counterpart for the air. Jullien wanted to build a large machine based on his model, but lack of money, ever the devil of the genius from the hut, made him abandon his plans and he died, a mere visionary in aeronautics in the eyes of the contemporary success-loving world.

Thus, the age of the dreamers of the



"An Improvement in Locomotive Balloons," patented by P. Haenlein, Aug. 27, 1872. An early patent and the first in which "a gas-engine" is specified as motive-power.

dirigible came to a close. Thousands of men, in addition to the few named above, unconsciously brothers in the advancement of the world, had seen their theoretical solutions of it. The time was ripe for practical builders to take the helm.

The first of these, Henri Giffard of France, who had what Jullien lacked, was inspired by the model of this last of the great ideas on the dirigible. From one invention, the steam injector used on the locomotive, Giffard had made a fortune which he now prepared to spend in the pioneer field of aerial navigation. Like the Wright Brothers, he went straight to the key problem of the remaining questions.

Relying on Meusnier, Cayley, Mason and Jullien and their co-workers for the form of the dirigible, he set to work in the development of a light-weight power plant, for which his past experience fitted him. After much experimentation, he succeeded in building a steam engine of three horsepower that weighed only 159 pounds. This he installed in a car which hung some twenty feet below an egg-shaped balloon with a length of 144 feet. The engine was connected to a three-bladed propeller.

In this balloon, Giffard rose over Paris on September 24, 1852. With the sparks from its boiler soaring upward over its hydrogen bag, it was like a cage of dynamite. In fear, he maneuvered it about the city, controlling it successfully in a light breeze and then landed. Thus, Henri Giffard became the first man to drive a powered aerial vehicle through the air and this September the twenty-fourth became a red-letter day in the story of man's conquest of his environment.

Time rolled on and hundreds of practical and impractical experimenters carried on the struggle to solve in a safer, more efficient way the problem of the dirigible. Working as individuals and alone, without a centralizing research director to guide them, usually without knowledge of the solutions of their predecessors, these men groped in the dark for a light. Many, in fact most, of their ideas consequently were fantastic in the extreme.

In 1884, thirty-two years after Giffard had pointed the way toward final success, Renard and Kreb, two French Army officers, pyramiding their efforts on the prior work of the Tissandier Brothers, built a dirigible and named it "La France." It was 104 feet long and about four feet in diameter—a long, slim envelope, powered by an electric motor.

On August 9th, 1884, this ship of the skies rose on its trial trip. The spectators marveled at the ingenuity of man as it began to cleave through the air in a long, majestic circle. It traveled five miles in twenty-three minutes and then landed. Few of the wondering watchers realized the full significance of what had happened. For the first time since man had been on the globe he had driven a streamlined airship through the air.

The ship was flown successfully six times, but students of aeronautics realized that, despite its ability to be steered, it had several serious drawbacks which made it of little use in transportation. Its power plant was so heavy that it could carry only few passengers and its non-rigid envelope was at the mercy of the winds. Inventors constantly worked to lessen both defects.

In 1897, Schwarz built and tested

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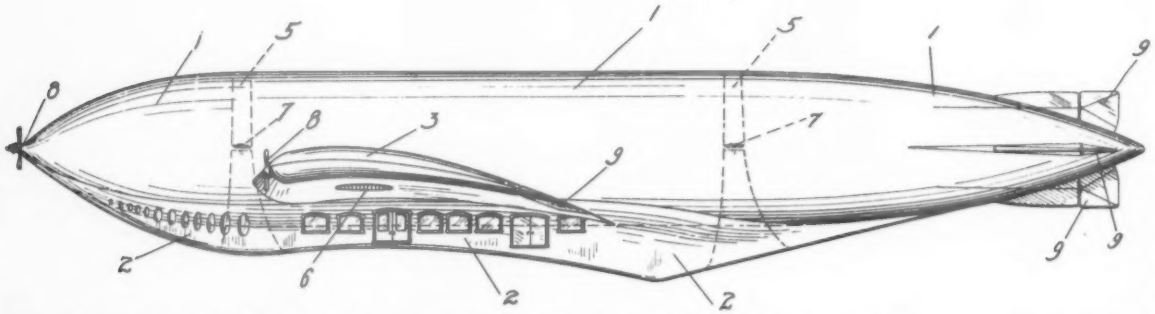


This is the airship invented by C. S. Hall, Dec. 21, 1921. As will be seen, the inventor has provided cambered airplane wings for this ship to assist the buoyancy.

250 Miles in a Parachute

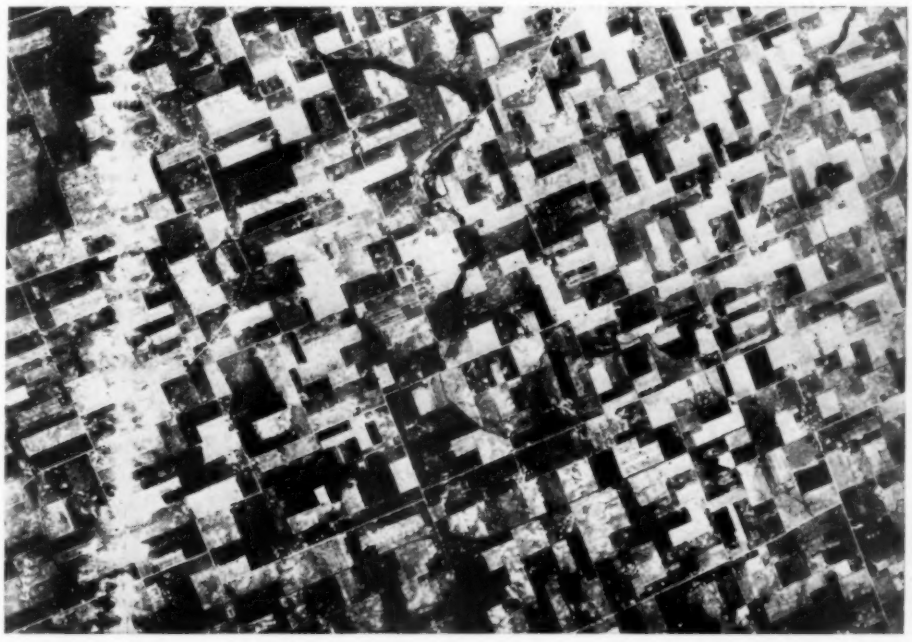
by JOE CRANE

A thrilling article on parachuting by the veteran parachute jumper, Joe Crane. Though pursuing a hazardous occupation, Joe has met with but few mishaps in his long career.

PARACHUTE jumping is my job. I've hopped out into thin air 551 times, an average of little better than one jump a week over the past ten years.

My lowest jump was from 400 feet and my highest one from 20,300 feet. As close as I can figure, I've traveled downwards some 250 miles. I've broken an ankle once, sprained an ankle once and both ankles another time. I've scratched myself and bruised myself considerably, and once I almost had an arm torn out of its socket.

I've landed on roofs four times—twice intentionally and twice in spite of everything I could do to prevent it. Once, when I came down in a lake, I was almost drowned. Just the same, I don't consider parachute jumping particularly dangerous—not near so dangerous as coal mining, for example.



Looking down upon Akron, Ohio, from 20,000 feet. Do you think that you could pick out any special roof in this densely settled district and land accurately upon that roof as Joe did? This is just the way things look to the man in the 'chute.

A quarrel with a corporal at Ellington Field, near Houston, Texas, started me to parachute jumping. I was too young to enter the service during the war, but in 1921 I enlisted in the aviation corps, with the hope of learning to fly. But when they discovered I could run a typewriter, they kept me doing office work.

Going down! Joe Crane is running up his mileage, or running it down, if you prefer.

One day I got into a hot argument with a high ranking corporal, who was a parachute jumper. He made me pretty sore about something—for the life of me I can't remember what it was. Anyway, I invited him to take off his stripes and step outside and that scared him pretty badly. When I saw how yellow he was, I thought, "Well, there can't be much to this parachute jumping if he does it—I guess I'll take a crack at it."

In those days, the army had a regulation that you had to attend a parachute school for five months before you could make your first jump. So I went to the adjutant and asked to be sent to the parachute school. He wanted to know why I wanted to become a parachute jumper. When I said, "for the thrill," he pointed out of the window to a flag pole and said if I was looking for a thrill I could paint it—it needed it badly enough.

"Yes, sir," I said, "but if I paint it will you let me go to parachute school?" He laughed and said, "Sure!" and I set out to paint that flag pole, which gave me plenty of trouble. It was 90 feet high and too large to be gripped with the fingers and too small to be held tightly with the arms. It took me two days to figure out how to climb it, after sliding back time after time. Finally, I got some rope, made a slip knot that could be tightened up as the pole got smaller, and fastened on two loops for stirrups. That's how I climbed the flag pole.

I went to the parachute school at Chanute Field, near Rantoul, Illinois, and I think the biggest thrill I ever got out of parachute jumping was the day the orders came through for me to go there. Well, after I arrived, I discovered there was a regulation that they had to have six men to take the course before they could start a class.

The place was really a recruit barracks from where they assigned new men to various outfits. Then I hit on a smart idea. I got busy on the recruits as they showed up and argued with them until I got a class of six all set to learn to jump, which took me about two weeks.

It costs about $20,000 to train an army pilot, so naturally, as a matter of economy, the War Department is against letting its pilots get killed, and that's why they have to wear para-

chutes. But somebody has to know how to fold the parachutes and test them. The school I attended was designed to teach enlisted men how to do that work.

The first month, men in the parachute school were put through a course about the same that you get in grammar school, just to make sure they had brains enough to be reliable. Then, we spent about two weeks learning woodwork, so we could make a box to contain a lead weight for testing parachutes before they could be used for jumping.

The next two weeks we studied wirework and had to splice cables, make wire frames for the parachute packing cases, and rip cord cables. All of those things can be bought in the commercial market—cheaper and better constructed. But we had to learn how to make them—I can't say why, unless it was the Army's desire for *thoroughness*. After that, we studied folding for two months, and then we were ready to be graduated—that is, ready for our first jump.

But they were short of planes and I was put off day after day for two weeks. I got so worked up over the delay, that when my time finally came I didn't feel excited about it at all. It was awful cold—I remember that.

In those days they wouldn't let us do anything except a "pull-off." We had to ride a platform on the wing of a plane, holding on to a rope, and when we jerked the rip cord in that position, the force of the wind yanked us off into space. That was supposed to be safer. In those days, they still thought that if a man fell a few hundred feet through space he would become unconscious, and they were afraid we might not pull the rip cord in time.

Since then, of course, it's been demonstrated that a fall through space doesn't cause unconsciousness. In a delayed-opening jump, a Russian recently came down five miles before pulling the rip cord to release his parachute and check his fall.

But my first jump was a "pull off," and the terrific force of the wind, snatching the rope through my hand, burned the skin off my palm. I had on two 'chutes and I'd been told to open the second one after floating down a bit with the first one—in order to prevent oscillation. If a 'chute is oscillating badly, as you near the ground, you are liable to land sideways—sometimes with enough force to knock you out.

With two 'chutes, there is no oscillation because you are suspended between them. On the other hand, it's practically impossible to steer with two 'chutes. Steering while coming down with one 'chute is fairly simple. You just pull the cords in the direction you want to go. The pull tips the 'chute, allowing air to slip from under the higher side, which sends the 'chute in the direction of the lower side.

On that first jump, I was aiming at the aviation field, and I saw the ground coming up pretty fast. I was just about 100 feet above it when I saw a lot of rocks that had been spilled from a road construction truck. There wasn't a thing I could do to miss them—not with two 'chutes. So I came down right on those rocks, sitting back on one heel, and spraining that ankle.

I continued to jump as long as I was in the army, but after my three-year term of enlistment was up, I didn't do any more jumping for a year. I worked as a professional steeple jack, contracting to paint flag poles, steeples, water tanks and smoke stacks. Then I got a job with a flying circus and went on a barnstorming tour.

The manager kept harping on the stunts that had been pulled by a Mexican daredevil that had formerly been with the circus. He said this fellow would fasten a rope to the fuselage and after swinging out from a wing, holding to the end of the rope, would

Standing on the wing of a plane, all Joe Crane has to do is to fall off backwards.

climb up the rope hand over hand to the cockpit and scramble in.

I didn't like that idea so much, but I said I'd swing off the wing in the same way, only I'd wear a 'chute, which the spectators on the ground wouldn't know anything about, and after acting as if I was climbing the rope, I'd pretend to lose hold and fall, making them think I was going to be killed, but ripping out my parachute after dropping a few hundred feet.

Well, this just goes to show that there are a lot of things you can overlook in this business. I thought we had the routine perfected in every detail. But I slipped up. You see, I never saw this Mexican do his stunt, so there was one thing I didn't count on. That was slack in the rope. The jump was made from the wing tip.

In order to take up the slack in the rope, which had the inner end fastened to the fuselage at a lower level than where you had to be out on the wing tip, it was necessary to jump out beyond the end of the wing. In other words, you had to make an outward leap in a direction perpendicular to the direction in which the plane was moving, so that the rope would swing down under the plane perfectly taut.

I didn't know this, and I simply dropped straight down off the wing tip, with the rope slack. When I swung down under the plane I got the most horrible jerk I've ever had in my life. I had the end of the rope in a loop under one shoulder—and my arm was almost torn out of its socket. My jumper sleeve and my shirt sleeve and most of the skin on that arm were peeled off clean, and I went down, head over heels.

I guess the spectators got a thrill, all right, and so did I. But the point is, if I had tried to do the stunt the way the boss said the Mexican did it—without a parachute, but with the intention of climbing on up the rope into the fuselage—well, I wouldn't be writing this story.

Another time I had a close shave was when I made my first water landing. We had that pretty well figured out too, but a sudden change in the direction of the wind almost fanned me out. I was coming down over Crystal Lake, near Lansing, Michigan. A motor-boat was supposed to be standing by to pick me up—and it was supposed to be *near* by, for I can't swim over 20 feet.

But the wind shift tricked us all, and the boat was a long way off when I approached the water. I saw that, but I had something else to think about first. That was getting clear of the parachute. I did that by having the belt unfastened just as my feet touched the surface, so I could wiggle free, and let the parachute float on down a few feet away from me.

I accomplished that successfully, but then there I was in the middle of that lake, and I was one of the world's worst swimmers. For a few minutes I was really annoyed—much more than I have ever been when watching the ground shooting up at me as I came down in a parachute. I took it as easy as I could, paddling a little and floating a little—until they got to me. I'm quite at home in the air—but not in water.

My first landing on a roof was at the time I contracted to play Santa Claus for a department store in Port Huron, Michigan. I was misinformed about the layout. I understood the store occupied one corner of a lot, the rest of which was vacant. As a matter of fact, the rest of the lot was covered by buildings with irregular peaked roofs. The spot I was to hit was 90 by 100 feet, thereabout.

I should have looked it over, but I didn't really have time. The advertising man assured me that all projections above the surface of the roof—he said there were some rods—would be painted white and a white cross laid out to mark my target.

(*Continued on page* 192)

American Warplanes in China

by HARRISON FORMAN

American built fighting planes, both of the light and heavy types, have been extensively employed in China. The author was formerly connected with the sale of planes and munitions in China and speaks with authority.

"BUT, how much does it cost?" That's one of the first questions asked in any language when a piece of merchandise is being offered for sale. Airplanes are no exception—even fighting ships, which must be constructed of the best of materials and equipped with the best of armament.

A first-class fighting ship—pursuit or observation, such as the Boeing P-12E or Vought "Corsair"—will cost in the neighborhood of $25,000.

"Of course, I know your ship is an excellent one—even one of the finest. And I have no doubt but what it will do all you claim. But . . . . . it *costs* too much!"

This was the consensus of sales resistance offered to us by the "Powers-that-Be" in the Chinese Government. We set to work studying the problem. There was nothing wrong with the price as far as dollar-for-dollar value was considered. Nor was there any competitor offering the same quality of fighting plane for an appreciably lower price.

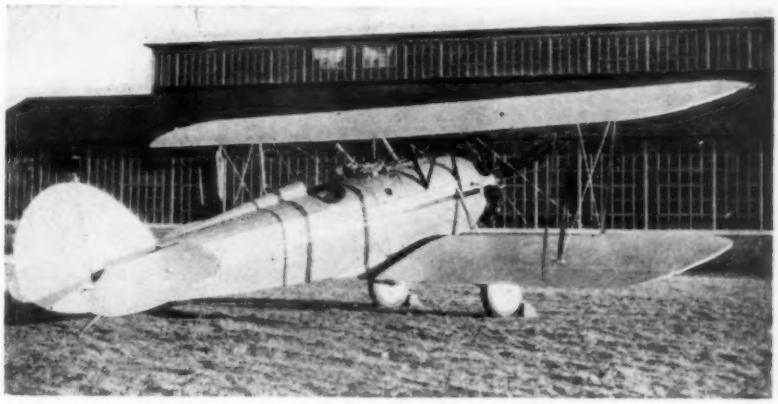
After all, what did the Chinese want fighting ships for? Surely, they had no immediate objective of building up an air force, comparable in strength to any present-day first-class Power? No. They wanted these ships mainly for use in ground-strafing and bombing of recalcitrant elements—communists, bandits, rebels, etc.

We consulted with American aircraft manufacturers. Waco and Fairchild took the matter up; and the result were the Waco "220" Taper-Wing and the Fairchild KR-34 Expeditionary models. Both ships were regular stock models, equipped with regulation U. S. Air Corps machine-guns and bomb racks.

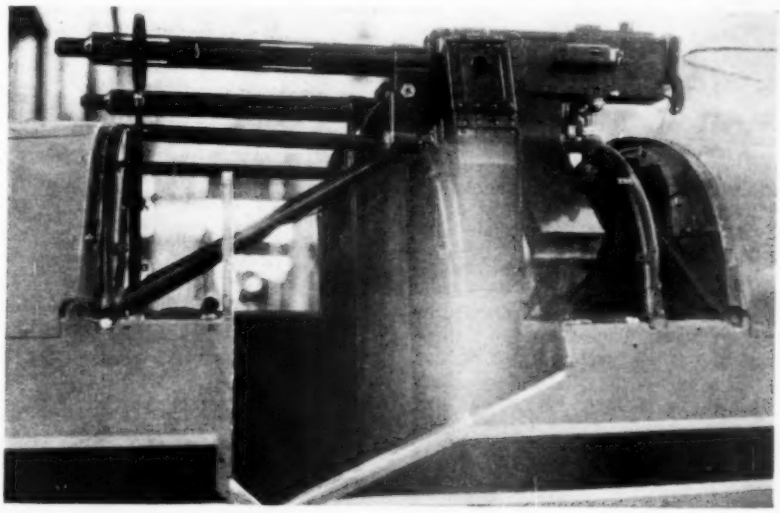
Since they were priced at less than half that of a Boeing or "Corsair" we immediately sold five Wacos to the Canton Aviation Bureau and two Fairchilds to the Szechwan Aviation Bureau. Unfortunately, we discovered that the light Fairchilds did not prove entirely satisfactory because the added burden of two machine guns and a bomb-rack was a bit too much for their 165 h.p. engines.

The Wacos, with their 220 h.p. Wright "Whirlwinds" proved so successful that the Waco engineers proceeded to develop this model. They subsequently produced the Waco Expeditionary Model 240-A (the converted stock-model Straight-Wing) and the Waco Pursuit Model 300T-A (the converted stock-model Taper-Wing).

These are equipped with the identical



The Waco plane all dolled up with machine guns and bomb racks for Chinese military service.



Machine gun mountings on the Waco.

The Fairchild KR-34-CA tried out in China.

military armament as specified by the U. S. Air Corps for Boeings—namely, two twin Browning .30 calibre machine-guns, synchronized to fire through the propeller arc with a standard U. S. Air Corps Type E-4 impulse generator, "ring-and-bead" sights and a U. S. Air Corps Type A-3 bomb-rack mounted underneath the fuselage just aft of the undercarriage—selective in action, and accommodating two alternate loads of either five 25-lb. Cooper or other fragmentation bombs, or two 100-lb. demolition bombs.

The 240-A is powered with a Wright 240 h.p. engine; while the 300T-A is powered with a Wright 300 h.p., or a 300 h.p. "Wasp Jr." So pleased were the Cantonese with the first lot of low-priced fighters that they ordered a lot of six of the newer Waco 240-A's. These are being successfully employed in bombing and strafing of bandits and communists and also for advanced training.

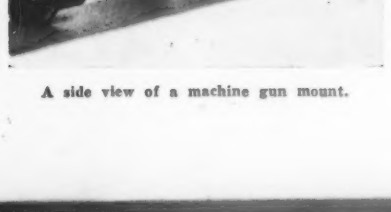
A unique feature of these ships is the demountability of the machine-gun mountings, which fill the front cockpit of the regular stock-model plane. When duals are then replaced the ship becomes an advanced trainer.

The Waco 300T-A is a particularly brilliant development. The reputation of the stock-model Taper-Wing is well established in competitive air shows. It holds the enviable distinction of being the first commercial ship to perform an outside loop. It may be readily seen, therefore, that pursuit ships may be faster in flight, but this ship being so highly maneuverable, it will more than counteract any speed advantage of an adversary—thus making it an able mount in any "dog fight."

A further study of the Waco Model 240-A will be of interest, particularly in respect to the performance with the full armament aboard. With a gross weight of 2,615 pounds, including gun

(*Concluded on page* 200)

Looking down the gun-alley of the Chinese Army Waco.



A side view of a machine gun mount.

Here's the Martin Bomber in Flight

On looking at this photo of the Martin bomber, we cannot help but wonder just how much damage she would be capable of doing to the city shown below.

THE MARTIN Bomber shown above in flight, was snapped at unusual moment by the photographer. That is, the photo included a bit of the terrain beneath so that, with a little imagination, we can at least partly visualize what would take place were this war bird to start laying her "eggs."

To protect such a city from the inroads of the fast Martin bomber would call for a large fleet of pursuit ships which, under wartime conditions, would be an expensive matter. So fast is this new bomber, it would be doubtful whether the pursuit planes could head her off before the damage was done even were they in flight, and they would offer no defense at all.

Notes on Entering the U. S. Army Air Corps

by RETTA EWERS

READERS of POPULAR AVIATION have, no doubt, often wondered what particular qualifications they should have in order to enter the United States Army Air Corps. A letter addressed to the Chamber of Commerce of San Diego, Calif., from Major A. L. Sneed, outlines with clear simplicity the prime requisites for successful entry into the Air Corps. It is reproduced herewith.

To San Diego Chamber of Commerce:

Dear Sir:

In compliance with your request contained in letter of February 24, I am submitting the following statement for incorporation for article in "P. T. A. Courier."

The Army Air Corps offer a fascinating career for young men of good education, sound health and keen spirits, whose inclinations are toward military aviation. Individuals between the ages of 21 and 27 years, who have had a two year college education, or its equivalent, and who are able to pass regular physical tests and possess desirable character, are eligible candidates for Flying Cadets.

The course of instruction lasts one year at which time prospective officers receive at Government expense, instruction among the world's best. In addition to board, room and clothing $75.00 per month is paid each student. Courses in navigation, meteorology, radio and other subjects allied with military profession are urged. Upon completion of the course, commissions are granted in the Air Corps Reserve, and the young officers become eligible candidates for the regular army.

Candidates who hold a degree from recognized colleges and universities, and possess satisfactory qualities of character, are accepted without mental examination, providing vacancies exist. Those who have had only two years of college training are required to be examined.

Pay and allowance for the newly appointed Second Lieutenants in the Army Air Corps amounts to approximately $245.00 per month, increasing gradually until retirement. An officer has no definite period of service but normally may resign at any time. *Great fliers are born and not made!*

The ability to fly well—to become a satisfactory military pilot—calls for a certain combination of psychological attributes not required by any other activity or effort of man. The majority of men, even the majority of men who desire to fly, do not possess these attributes. Years of research and experimentation have enabled the Army Air Corps psychiatrists to isolate within certain limits those applicants who have flying ability.

The great majority of those who apply for admission to the Air Corps Flying Schools are eliminated, either when application is made or soon after training starts. Promotion is not rapid but steady and certain. Those to whom military aviation appeals will find it a varied and interesting career.

Letters From Our Readers

Interesting comments from our readers picked at random out of our mail. They come from far and wide and display a multitude of opinions on all sorts of aviation subjects.

WE have been getting from time to time, a lot of interesting letters from our English friends and readers and the following missive from G. A. Walter, Station House, Swanburne (near Bletchley), Bucks, England, that will be of particular interest to our light-plane fans and home-builders who believe that they have the only disappointing experiences in the world. You have the floor, Mr. Walter.

After seeing your little note in "Airy Chat" for February, I rushed for pen, ink and paper to let you know what some of us chaps over this side of the ditch think.

It's just the same over here. We amateurs can't do a bally thing except armchair flying. The cost of instruction over here is about £4 per hour ($18.50) at the best schools, so this rules most of us out. We can't even build a plane as an experiment, or with the intention of flying it, unless the Air Ministry pass our plans and give us official permission.

Of course, you can guess there are only a very few "fresh" designers allowed to do anything (two in the last year). Amateurs can do nothing except build and fly gliders without authority, but even then the gliding grounds are few and far between.

The great thing to be overcome is our old friend "stress analysis." Now it's no good for us to just sit still and just grouse about our rotten luck. Why can't we be up and doin'? Could you go through lightplane design in several snappy articles? I know that this sounds a tall order, but if it could be done, a good percentage of amateur designers could get their plans past the Air Ministry censors and you know how they would feel about that.

The best articles of your magazine (the best of its kind) in my opinion, are those of Mr. Vernon Payne. They're the dope we want—let's have some more of them. For goodness sake keep up your "Practical Lessons," I nearly had a fit when I couldn't find this article in February's issue.

Here's a list of the type of article I should like to see published: Propellers and How to Make Them; Engine Mounting and Converting; Position of the Thrust Line and the Angle of the Stabilizer; Finding the Center of Resistance, etc.

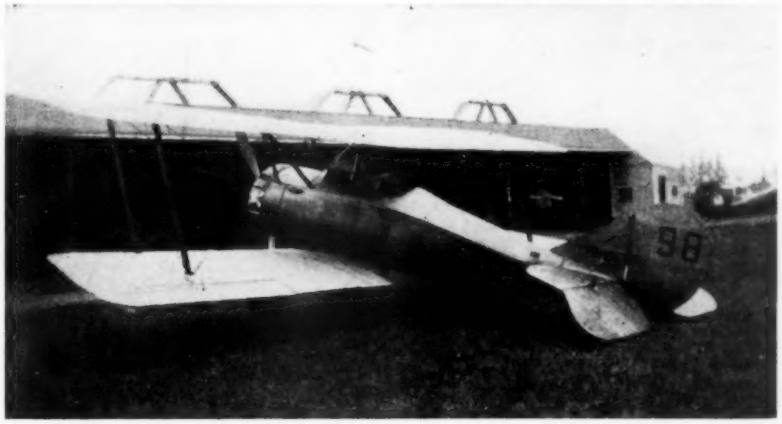
Now, Old Chap, what about it? Don't get us crazy about flying and then fail to get us up in our homemade crates. The photos you publish are to us as a red flag is to a bull. They make us want to smash things, especially fool laws and their makers. We want to be able to send you photos of our own ships, so give us a chance if you can.

Now, here's a suggestion. Why not publish a little book dealing with airplane design? Write it so that any really keen reader with general ideas on flying, on properly digesting it, can design a ship that would pass all the theoretical tests set by our Wet Blankets in office. Sufficient instructions on stress analysis, to be included, of course.

Your several articles on design and construction only whet our appetites and make us tighten our belts, especially as we cannot do anything in the matter at present. We're under to our necks on this side as well as your plane addicts. Don't give us a push or let us stay where we are, but pull us out. By the way, if this note reaches your "Readers' Letters" column, I shou'd like to hear from some of them and exchange ideas.

We only wish that we could straighten up our own difficulties with fool anti-aircraft legislation but we thank you for your confidence just the same. At least one of your requests will be answered—that of the series on lightplane design. This series was started in the June issue.

* * *



The old Thomas-Morse, or "Tommy" formerly owned by Koenlein and described in his letter. "It was the sweetest ship I ever flew," he says, and many others will back him up in this statement.

WE ARE indebted to Mr. Fred C. Koehnlein, 77 Holbrook St., Rochester, N. Y., for this picture and description of his S-6 Thomas-Morse two-seater. He writes:—

"'Salvaging Wartime Junk,' an article which appeared in the August issue of POPULAR AVIATION, tempted me to sit down and write these lines which may, or may not, be of interest to some of your redaers.

"The author explained how he and many other pilots had changed their Thomas-Morse single-seaters into two-place jobs. He also stated that the company which manufactured these Tommies had turned out a few two-seaters.

"I am enclosing a snapshot of the Thomas-Morse S-6 two-seater which I flew all through the summer and fall of 1931. It was the sweetest ship I ever flew. It crashed in the fall of '31 or I would be flying it yet. However, the most interesting thing about this ship is that it was the first two-seater Tommy ever made and bore the manufacturer's Serial No. 1.

"It was powered with the conventional 80 h.p. LeRhone rotary engine and its performance was amazing. Previous to this S-6, I had owned an S-4 single-seater. By bargaining, I was able to trade ships and benefit by a ship that could carry a passenger, though I later regretted it.

"It is interesting to note, that after I had crashed nose-first from a spin, examination showed that the motor had only been shoved back about one inch. The front cockpit was damaged very little."

* * *

WE have a letter from Thurman C. Erickson, president of the University of Minnesota Flying Club, which will contain good news for many of our readers.

The University of Minnesota Flying Club, winner of second place in the Loening Competition of 1933, is attempting to create a national organization of flying and glider clubs. We have succeeded so far in obtaining the sentiment of some 250 colleges throughout the United States and at the present time are engaged in drawing up a tentative constitution.

The object of this organization will be to foster collegiate aviation, to stimulate interest in coordinate flying activities and to promote the mutual educational welfare of the members. We would appreciate your assistance in bringing this matter before the public.

Therefore, we suggest that members or officers of collegiate flying clubs get into communication with Mr. Thurman, president of University of Minnesota Flying Club, College of Engineering

and Architecture, University of Minnesota, Minneapolis.

* * *

DO you remember the letter from the pro-race fan that we printed in our June issue? Well, here's a letter from W. R. Privette, Abita Springs, La., one of our old readers and well experienced in aviation, who does not believe that air-races are for the good of aviation. Mr. Privette's letter is dated February 18, 1934, and while the publication is considerably belated, we did this in order that you might read the other comment first.

I certainly agree with your view on air racing. The article by William Ong, "Death Stalks the Air Races," was proved here in New Orleans this week.

First, Capt. Merle Nelson was killed in a night crash. He was flying a so-called rocket ship, fireworks being used on his plane. He was blinded and flew into the ground full throttle from 600 feet. Friday, I saw Harold Newman flying a Howard Special, "Mike," turn completely over on a forced landing.

Yesterday, two more were killed—a chute jumper and a pilot. The enclosed clipping tells the story. Besides these accidents, there were several minor spills and duckings in the lake at which this airport (Sushan Airport) is located.

Today is the last of the races, and there may be more accidents before it is over. I hope not, as aviation has suffered a severe setback here due to these accidents and deaths.

* * *

NOT long ago, we heard from a member of the old "Round Robin Club" that was sponsored by POPULAR AVIATION several years ago. And here is what he has to say:

"My name is Joe Greiner, perhaps you remember me and perhaps you do not. But anyhow, I'm one of the old Round Robin members who got a lot of kick out of that organization. I wish that you would please publish this letter so that I can present my best wishes to the old gang."

Thanks, Joe. We looked you up in the old register and find that you are all that you say you are. Mebbe some of the gang will turn up and help you get lined up again.

* * *

STRANGE how some of these birds remember articles in POPULAR AVIATION that were published 'way-back-when. Here's an old-timer, Elbert H. Wiggins, who digs up a few dry bones:

"Those Italians are going to get you, boy. They're sure going to show you 500 miles-per-hour before the season is over and what are you going to do then? I am willing to bet that it will be 600 miles-per-hour before another five years pass. Ain't you sorry that you wrote that article, '500 m.p.h. Can't be Done'?"

No, Mr. Wiggins, no, no, no. I'm not sorry a bit. Always remember that the last 5 m.p.h. always come hardest. A speed of 423 m.p.h. is a long way from 500 m.p.h. with the head resistance stacking up about five times as fast as the power.

Airplanes Stored on Movable Trucks

This is a photograph of the model hangar which shows the handling system at LaGrande, Ore.

THE illustration, which appears to be set of toy planes, is a model of the hangar system used at the La Grande Oregon airport. It was devised to save space and time in handling aircraft. It does away with plane-pushing by attendants who shove the low-wheeled trucks instead.

The ship taxies up the ramp to the truck, which is shunted by hand into the hangar. This system allows storage of *three* planes in space formerly required by *two*. Permits rapid removal in case of fire or emergency, thus saving thousands of dollars.

In case the first plane *in* is required, the other two are wheeled on the tracks past the ramp and then rolled back, after No. 1 is removed. The system is patented.

Flaw Detection

AERONAUTICAL engineers have taken to sprinkling salt on airplane tails.

Not to tame them, but to detect flaws in metal parts; flaws invisible to the naked eye but which might mean death to pilots or passengers later.

The new white iron salt and its value to the industry was demonstrated for the Institute of Aeronautical Science in New York by A. V. DeForest, New York engineer.

He laid a number of steel airplane parts, such as valve springs, pipes, rod and metal straps, on a table. They appeared to be perfect pieces of metal. A shake of white salt over a piece, a light tap against it, and here and there the salt had gathered in fine lines, resembling scratches. The lines were cracks in the steel.

The engineer took up a short length of pipe and repeated the process. Its crack was inside, yet the revealing streak showed outside.

In explaining the test, Mr. DeForest said the salt gathers to show the cracks after the metal has been magnetized. The salt is finely ground pieces of iron, their shapes flat. They are coated with zinc oxide and talc powder to make them visible and slip easily.

This method is fast supplanting the older and more expensive X-ray system of flaw detection.

Tetrachloride Fumes

DR. RICHARD U. LIGHT, a professor in the school of medicine at Yale, had a narrow escape while flying alone the other day from Framington to New Haven, Conn.

He developed a headache, despite the fact that the windows of his cabin were open, and also noticed an unusual odor, much like that of chloroform. When he began to feel dizzy he made an emergency landing in a meadow.

After his head had cleared, Dr. Light sought the cause. He quickly found that the fire extinguisher, which contained carbon tetrachloride, had discharged about half its contents and was too hot to touch.

This substance is of great value in fire protection in airplanes, the professor pointed out later, and since the Department of Commerce has ruled that every plane must carry a fire extinguisher, has led to the almost universal practice of installing a container of carbon tetrachloride.

But, Dr. Light warns, the manufacturer and pilot as well should bear in mind that poisoning and even anesthesia may follow the escape of the liquid into the cabin of an airplane.

The purpose of the tetrachloride is to surround a blaze with a blanket of extinguishing vapor emitted by the liquid. This is safer and more certain than water.

On the Outside Looking In

by BARBARA POOLE

In which the author wildly laments the attitude of the he-pilots to the she-pilots, et al. You'll get many a chuckle out of this monologue and plenty of food for reflection as well. The poor gals do have a rough time.

MAY this tired and bewildered female pause to inquire wearily of the world at large: "What in blank do men pilots expect from women flyers anyhow?"

Wait a minute, brother, don't tell me yet. First, let me tell *you*—and then if you can still think of something to say, you're wasting your time as an aviator, boy. Congress is crying for someone *that* good at explaining things, right now.

When I left home at just sixteen and went to flying school, I honestly personified that much abused term—"a nice girl." Oh, I knew there wasn't any Santa Claus all right, but I had just graduated from a convent and didn't drink, smoke, swear, date or chew.

I thought the world all sweetness and light and that aviators were unsurpassably fine, upright men. Heroes! Young gods (pardon me while I die laughing will you?) and whatnot. I was the only girl among ten or twelve boys, whose dislike I immediately earned and kept all the while I was at the school.

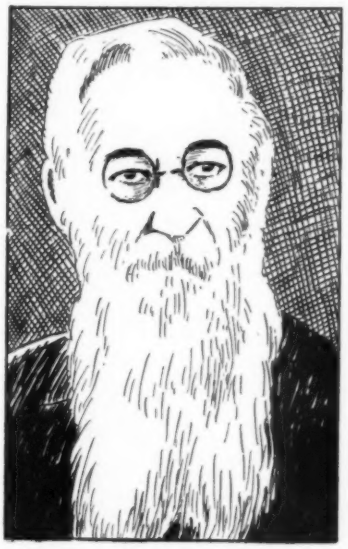
I was too "goody-goody," a "prude," "dumb" and a "horses-neck"—so descriptive that last term, don't you think? Very well. I set out to make me over and succeeded beautifully, I'm sorry to say, in everything but learning to chew, for tobacco makes me sick and I always swallow gum.

I then went back East to a large airport, confident in my poor misguided way that the pilots would now consider me "one of them." Of course, I now realize that the only way that a woman flyer could ever become "one of them" would be for her to perform a miracle that even nature has had trouble with so far. But in those days I was shocked to discover that, according to this next bunch of pilots, I was "loud mouthed," "tough" and "trying to ape the men."

I suppose the obvious reply to all this is that I should simply have been myself. I agree, but that is impossible. A woman cannot remain natural around an airport. A woman cannot remain unobtrusive and sexless around an airport. The majority of the men are all right, yes, but there are always those few who cannot seem to remain impersonal with a woman and who are continually making suggestive remarks to her, preferably in the presence of the other men.

If she stays and laughs at the jokes, she's "common." While if she gives way to an aversion to such things and walks off, she's a "pain-in-the-neck" (I moved it up myself, Mr. Editor). And then, too, practically everybody around an airport is an incurable gossip, and the woman who happens to be flying there is one of the principal topics of conversation. How can anyone remain natural under such constant surveillance?

And now we come to the subject every male pilot is certain to start wailing about within the first five minutes of any conversation even remotely concerned with women flyers—motors. Frankly, I, as one woman pilot, don't know anything about motors on airplanes, in automobiles, electric refrigerators, electric fans or automatic elevators either, for that matter, although I have passed a D. or C. test on them.



Prof. Thaddeus Quincy Socrates who has been deeply studying the air-port-women for many years, but as yet without any particularly accurate deductions. Perhaps, in 1955 he will arrive at a solution of the problem.

I can talk a good motor, oh, I can talk an excellent motor, but, somehow, the nearer I get to one of the fool things the less it seems like a motor and the more it gets to be a great big mass of metal that makes a loud but very comforting noise when one is in the air. The main reason for this is that I invariably went to sleep in class while attending ground-school, a habit which I had not been out of high-school long enough to overcome.

When I first went to work at flying, however, I really wanted to learn motors, but the boss refused to be bothered with me. "You're a woman," he said, "and you already know enough for any minor difficulties you may encounter. As for anything more, or for swinging props, there will always be men around for those things." And there the matter rested. Since then I have been laughed at, jeered at, criticised and bawled out for my lack of mechanical knowledge. Yet I still want to learn, though I must admit that the first fine frenzy has become somewhat frayed.

It's like this. When I ask questions they are either laughed at with that indulgent, "little woman mustn't bother 'ittle head with such great big questions" that makes me want to scream loudly and commit physical violence or else I'm a "pest." If I don't ask questions, I'm "indifferent" and "not showing any interest."

Which brings us right up to the painful subject of bosses. When a man hires another man there isn't any question of romance, is there? At least I hope not. Why is it, then, that so many employers expect their lady pilots to be their lady friends? Now, please don't get me wrong, I'm not conceited. I'm just a great big fat blonde and nobody's prize package, yet I've been fired from several jobs on this account.

Why? Not that this is always the case, although I almost always thought so until about eight months ago. At that time there was a job open that I wanted rather badly as it meant I would really learn stunt flying with a famous pilot. So I took stock of myself and I sez to me, I sez: "Keed, it's taken you over three years to get in 97 hours and you've worked hard for every damn one of those. Yet other gals, with no more money and no more ability, zoom right ahead with five times as many hours. Mebbe those pilots who eased you out were right, mebbe you're not 'wild' enough, my girl."

So, of course, this umpchay, still aiming to please, decided to be devastatingly "wild." The effort included a well known pilot, who had the final say on the aforementioned job. Well, it just happens that for some disgusting reason, every time I try to be wild the results are only ludicrous and this time was no exception, much to the extreme amazement of the w. k. pilot. P. S. I didn't get the job. Now get the reason why. My character was being tested. It wasn't because I hadn't been "wild" enough but because I had made an effort to be "wild" in the first place. Can you beat it?

I have 160 hours now and a permanently nasty disposition. I have four years behind me of working for bosses who have gypped me in every sort of way. Partially, I suppose, because my disposition wasn't at all nasty when I started out and mostly because I am a

woman and they knew I couldn't retaliate.

One was a drunkard who paid me on percentage and was eternally owing me till "Tuesday." He never mentioned the month or year but I am beginning to doubt whether he was referring to this century at all. Believe me, I've worked on straight living expenses since and what man would work that cheap?

I've spent most of my weekly five bucks from home on the outfit instead of myself. I've sweated many times at advance work I wasn't hired for and filled in at times of emergency on exhibition 'chute jumps without receiving a cent for any of it.

I've learned to cook and wash and scrub to save the members of the outfit money and then received seven hours flying time in four months as payment. I had one boss with a disposition like a honey-bear without the honey and another with a jealous wife. Both were simply impossible. Oh it just makes me boil to think of it!

I can't help telling you about my last boss before leaving the subject (as I wish I could permanently!). Several months ago I came up to the middle west to fly for a man who couldn't fly himself and although it was nasty cold, he assured me that he had use for me. I arrived to find the gentleman with fifteen cents in his pocket and no gas in the airplane, no prospects and a family that didn't like lady pilots, pilots, aviation nor airplanes—and I think I might include birds, bees, and all flying insects, although I've never gone that far into the subject with them.

A trifle disheartened, I, nevertheless, went ahead and did some promoting, got us a living and grabbed me a lot of hours, for once. And then I cracked up unavoidably. Not because that little detail matters, but because I'm a woman, I cracked up, voila! I'm wondering if I'll ever live it down, or if anyone will pause to ask, "how come?"

But the attitude of all male pilots is concisely summed up in the expressive, if terse, remark of a very irate gentleman one balmy summer's eve, some time ago. It all started with a Curtiss Junior having a temperamental little motor which positively refused any water with its gas and an urgent desire to fly, which is a recurrent brainstorm on all balmy summer eves with me.

Anyhow, to burden you further with the story, the field where I was flying ran north and south right along the pavement. As I prepared to take off from the southeast corner, rising over the road, I noticed a car rushing up along the road at excessive speed.

Thinking what I fool he was to take such chances, I started down the field. He too noticed me, I suppose, and thinking just about the same I fancy, he nevertheless expected me to con-

(*Concluded on page* 190)

With the Aero-Sportswomen

by JOAN THOMAS and HELEN WATERHOUSE

THE Century of Progress dinner in the beautiful and exclusive Trustees' Lounge, and Major Chester Fordney's fascinating personal account of the Stratosphere flight, made the meeting of the North Central Section of the 99's on July 7, a memorable occasion for those privileged to attend.

Another item that contributed much to the pleasure of the visiting pilots was the "Courtesy car" service furnished by the Ford Motor Company through the kindness of Mr. Walter Patterson. In fact, several of the girls said that it was the nicest part of the whole trip—the courteous college-student drivers in the trim tan cars seemed to have made a tremendous impression.

Mrs. Mabel Britton, the Governor of the North Central Section and her husband Dr. Britton, flew over from Ypsilanti in their Waco. Jeanette Lempke of Bay City, Michigan, flew in with her little red and white Great Lakes and Alma Arlene Davis of Cleveland, arrived on the United Airlines.

Michigan was also represented by Margaret Horton, Alice Hirschman, Faye Davies, Helen Lehtio and Gladys Hartung, all members of the 99's and two guests Florence Swanson, a student flyer and wee Joyce Hartung, a second generation 99'er, aged 3½ years.

In addition to Mrs. Davis, who is chairman of the Cleveland chapter, Ohio was ably represented by Abbie Dill, Peggy Albertson, Clara McCormick, Mary Winstanley, Ann Barille and Florence Cochran. Indiana and

Mrs. Mabel Britton, Governor of the North Central Section of the 99's, attended the meeting.

Iowa each had one representative, Shirley McKittrick of Indianapolis and Belle Hetzel of Avoca.

Clayton Patterson and Gayle Pond upheld the honors for the Illinois 99'rs. Other guests at the dinner who are pilots, former pilots, or students, included Mrs. Phoebe Terry, Gertrude Katzenberg, Marguerite Green, Katheine Lindemann, Dorothy Ring, Helen Colton, Helen Budwash, Mrs. May Wil-

(*Concluded on page* 194)

Sally Rand (right), has a heart-to-heart chat with Helen S. Waterhouse, the "Flying Reporter." Sally Rand, be it known, held a transport pilot's license at one time.

1934 Additions to the Waco Line

Two new Waco planes are announced by the Waco Aircraft Company, a new 3-place open job and a cabin plane.

TWO new Waco planes are announced by The Waco Aircraft Company, Troy, Ohio. They do not represent any marked structural changes over the corresponding previous models but contain numerous refinements in detail that add to the performance and comfort of the planes.

A new open job, the F-3 3-place Waco, is being offered with a choice of a Continental 210 h.p. or a Jacobs 225 h.p. engine. Equipped with the Continental R670 engine, it has a top speed of 143 m.p.h., a cruising speed of 128 m.p.h. and a landing speed of 47 m.p.h. Its climb at sea-level is 1,100 feet per minute and it has a service ceiling of 14,500 feet. At present, there is no data available on the performance with the Jacobs engine.

Conventional construction is followed throughout, employing wood wing structure (fabric covered) and a welded steel fuselage, also fabric covered. This ship has a full NACA cowl.

SPECIFICATIONS OF THE F-3 WACO

Wing Span	30′-0″
Wing area	233.5 sq. ft..
Length overall	23′-1¾″
Height	8′-5⅜″
Weight—empty	1,485 lbs.
Useful load	1,015 lbs.
Payload	515 lbs.
Gross weight, loaded	2,500 lbs.
Wing-loading	10.7 lbs/sq. ft.
Power-loading	11.9 lbs./h.p.
Factory price	$5,225.00

Waco Model C, is the new 4-place cabin plane which will also be offered with a choice of either of the engines noted above. It has a full NACA cowl, greater passenger space and a deep wing-root fairing. It has all of the stability of the earlier model that has made it so popular in the past.

As in the case of the F-3 open-cockpit Waco, the wings are of wood, fabric covered while the fuselage is of the conventional fabric covered welded steel tube type. Waco patented landing-gear, Auto-Fan brakes and Auto-Fan wheels are standard equipment.

Equipped with the Continental R-670 engine, this cabin job has a top speed of 143.5 m.p.h., a cruising speed of 128 m.p.h. and a landing speed of 53 m.p.h. The rate of climb at sea-level is 700 feet per minute while the service ceiling is 13,000 feet. The gasoline consumption is 13 gallons per hour with full load.

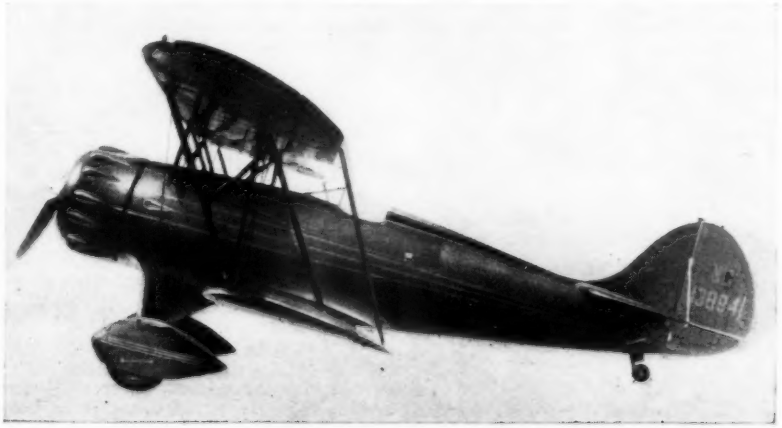
SPECIFICATIONS OF WACO MODEL C

Wing span	33′-2⅝″
Wing area	240 sq. ft.
Length overall	25′-2½″
Height	8′-6″
Weight—empty	1,765 lbs.
Useful load	1,235 lbs.
Payload	745 lbs.
Gross-weight, loaded	3,000 lbs.
Wing-loading	12.5 lbs./sq. ft.

Here Are the New 1934 Waco Planes

The Waco Model "C" Cabin plane in flight is a trim looking well performing plane with a "top" of 143.5 m.p.h. when equipped with a Continental R-670 engine.

Three-quarter view of the new Waco Model F-3, a 3-place open job equipped either with a Continental 210 h.p. or a Jacobs 225 h.p. engine.

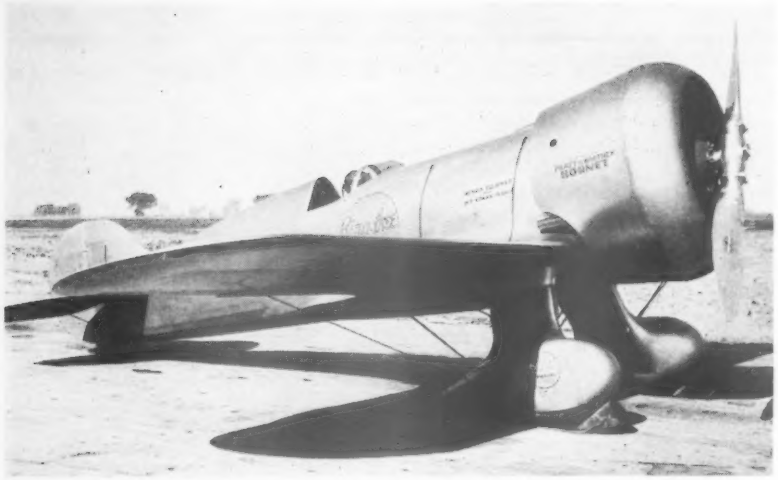


A side view of the Waco F-3 O.C. plane shows a carefully streamlined fuselage and well developed landing-gear fairings.

Keith Rider Is Attempting A

by

THOS. E. STIMSON, JR.



Roscoe Turner's special racing plane, now equipped with a new engine. A racing ship of this type may set a new world record for landplanes this year.

A NEW campaign is under way to enable man to fly faster than he ever has before.

Two things that have retarded the dizzy race for new records—the inability to land safely in a high speed airplane and the lack of suitable engines—are being overcome and now racing planes that can fly 500 miles an hour or better are being talked about by conservative engineers.

Two things about this desire to fly faster stand out: First, the next record probably will be made in an airplane built in the United States, and second, it undoubtedly will be a landplane instead of a seaplane. To date, man has flown fastest in a seaplane, the world seaplane record of 423 miles an hour held by Italy being more than 100 miles an hour faster than the landplane record.

The reason for this is that—in the past—the fastest airplanes were built to compete for the International Schneider Cup race and the rules for that competition called for planes that could take off from water. Landplanes, however, are inherently faster than seaplanes. Designers explain that the cumbersome pontoons prevent a seaplane from attaining its best possible speed.

The record breaking seaplanes require a long stretch of smooth water for landing and, even under the best conditions, the pilot risks his life in every landing. Until recently it was thought that a landplane capable of creating a new speed record was impractical because an extraordinarily long field would be needed and because the feat of "sitting down" at 125 miles an hour or better was too dangerous to attempt. Now that wing flaps have been developed, however, a high speed airplane could land on nearly any field at a safe sane speed.

Although no aviation engines have been built in the United States that compare with the closely-guarded high-speed power plants built by England and Italy for their Schneider Cup racers, several domestic manufacturers are planning to build comparable engines. Harry Miller, long the dean of American race car builders, may be in the field with a 2500 horsepower engine this year. Such an engine would not quite equal the foreign engines in power, but it would be several times more powerful than the largest engines that have been used for landplane racing.

John Stock, of the National Advisory Committee for Aeronautics, asserts that by using an engine no larger than those already built abroad and that by applying known principles of aerodynamics to the design and construction, an airplane could be built that would fly 554 miles per hour, beating the present record by the tremendous jump of 131 miles an hour.

Such a speed machine would be a highly streamlined monoplane of 29 foot wing span. The fuselage diameter would be only 40 inches and the plane would be fitted either with retractable landing gear or would be launched from a catapult and landed by skidding on its fuselage.

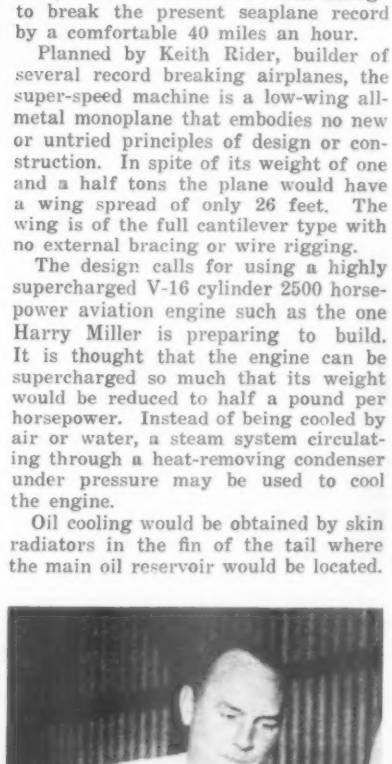
An aviation engine of 3000 horsepower or some improvement such as a more efficient propeller would give the plane a speed of 600 miles an hour, 80 per cent of the speed of sound. A one-bladed propeller, for instance, would be more efficient than the present type if some means could be devised for balancing the single blade.

Among the speed planes that are now actually in the designing stage is one that has a mathematically estimated top speed of 465 miles an hour. Not so fast as Stock's ideal conception, to be sure, but it would still be fast enough to break the present seaplane record by a comfortable 40 miles an hour.

Planned by Keith Rider, builder of several record breaking airplanes, the super-speed machine is a low-wing all-metal monoplane that embodies no new or untried principles of design or construction. In spite of its weight of one and a half tons the plane would have a wing spread of only 26 feet. The wing is of the full cantilever type with no external bracing or wire rigging.

The design calls for using a highly supercharged V-16 cylinder 2500 horsepower aviation engine such as the one Harry Miller is preparing to build. It is thought that the engine can be supercharged so much that its weight would be reduced to half a pound per horsepower. Instead of being cooled by air or water, a steam system circulating through a heat-removing condenser under pressure may be used to cool the engine.

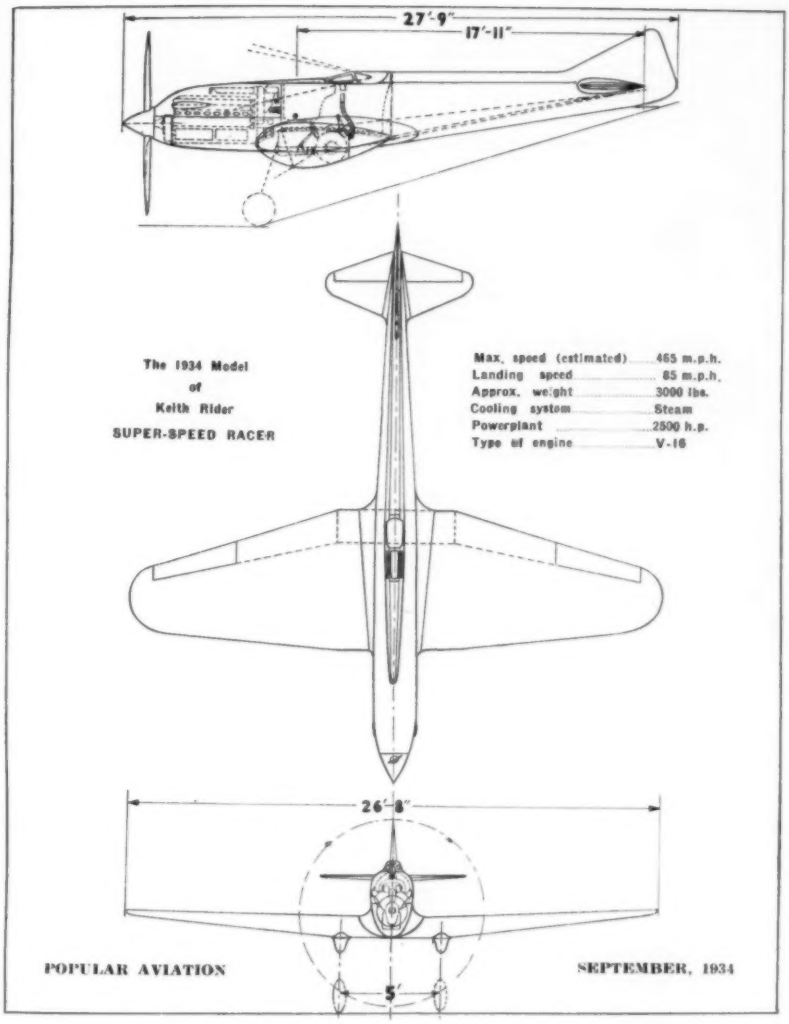
Oil cooling would be obtained by skin radiators in the fin of the tail where the main oil reservoir would be located.



Keith Rider, well known for his speedy racers, may set a new landplane record.

A Super-Speed of 465 M.P.H.

THIS article, describing the new plane being built by Keith Rider, shows the latest trend in racing plane design. In many respects, this plane follows the general plan of the Schneider Cup seaplanes except, of course, for the retractable landing gear. This article was read and approved by Keith Rider.



The engine would be geared down to a 9-foot propeller. At wide open throttle the engine would consume one gallon of gasoline every 15 seconds and only enough fuel could be carried for a flight lasting 40 minutes. But in that length of time the airplane would travel 300 miles.

A controllable pitch propeller would be used to obtain the greatest speed from the plane, and wing flaps under the trailing edge of the wing and extending across under the fuselage would permit the airplane to land at less than 85 miles an hour. The design also calls for landing wheels that fold up into the wing in flight and that are concealed by covers to complete the streamlining.

Since the last few miles of an airplane's speed depend upon the degree to which streamlining is carried, even such small details as rivet heads on the wings would have to be eliminated.

This would be taken care of by countersinking the rivets, thus reducing air friction and giving the plane a considerably higher top speed than it otherwise would have. The frontal area of the fuselage, 31 by 18 inches, would be barely large enough to surround the engine and the pilot would have to squeeze into slightly smaller dimensions in the cockpit.

Although a skilful and daring pilot is needed to extract the best speed from a racing plane, speed is really created on the drafting board instead of on the race course.

"A racing airplane's wing is only large enough to enable the plane to carry its own weight," Rider says. "Every square inch of surface removed from the wing reduces its drag, allowing the plane to travel faster. That is why a racing engine must be light weight in spite of its power."

One of the racing planes designed by Rider, a low wing "bumble bee" having only 77 square feet of wing surface and powered by a 180 horse power engine, recently defeated a much larger plane equipped with a 600 horse power engine. The small plane was clocked at 210 miles an hour, nearly 20 miles an hour faster than its competitor. Rider explains that the wing of the heavier airplane, larger than it needed to be, held its speed back so much that the tiny plane with the low powered engine was able to beat it.

"A pure speed machine would consist only of a propeller, engine and wing," Rider says. "If some other means of controlling the plane could be devised, the inefficient control surfaces of the tail could be removed and the entire tail eliminated. Until that time, we compromise by making the tail surfaces as small as possible. A pilot has to have extra-fine control of a racing plane at all times, for at 300 miles an hour an airplane travels 50 feet during the time a pilot's nerves are transmitting a brain message to his arm.

"Another thing that makes an airplane fast is cutting down the frontal area of its fuselage. Every inch that these dimensions can be reduced increases the speed. This explains why in-line engines are the best for racing. The large frontal area of a radial engine provides so much drag that speed is obtained only at a heavy waste of horsepower. One racing pilot recently installed a 1000 horsepower radial in his plane, just twice as powerful as his former engine. But the new engine has 10 inches greater diameter and as the result his plane is less than 25 miles an hour faster than before.

"The latest development in engines is a double-row radial that has seven cylinders staggered to the rear of the front-bank of cylinders. Although this engine rates at only 700 horsepower, its dimensions are so much smaller than the larger radials that it may be able to pull an airplane faster than the larger engines could. With some such radial engine the world speed record for landplanes, now nearly 306 miles

per hour, may be boosted to around 325 miles an hour this season."

What is the fastest that man will be able to fly? Engineers hesitate to set a limit to his speed, although many of them think that 660 miles an hour just about represents the top speed of the present type of airplane. And that speed would be obtained at an extravagant expenditure of horsepower.

The reason why they can set this theoretical limit is because they know that when a body such as an airplane wing moves at a speed approaching the speed of sound the molecules of air strike it and fly off in all directions instead of flowing smoothly around the wing and giving it lift.

Approaching the velocity of sound, the resistance builds up tremendously. It no longer follows the old law of "velocity squared" as at the lower speeds but rapidly builds up to the fifth power instead of the square. Up goes the horsepower with a rush for each additional m.p.h. gained so that an additional 10 m.p.h. may mean an additional 100 horsepower.

They know that when a propeller blade approaches the speed of sound it manufactures noise instead of pulling the airplane faster. Man may eventually fly faster than sound, the engineers concede, but it probably will be in some type of rocket instead of in airplanes as we know them now.

END.

An Aviation Engine Quiz

by P. A. TECHNICAL STAFF

Q. Are two spark plugs more effective than one?

A. Yes, they cut the distance of flame spread by about one-half, and add from 15 to 20 percent. to the output of the engine. Further, if supplied with current from independent sources, they add to the reliability of the ignition.

Q. At what time does the spark occur?

A. If the mixture burned instantly, the spark would occur exactly at the instant that the piston reached the end of the compression stroke. But as the mixture requires time for burning and as it is desirable to complete combustion as nearly as possible before the piston starts moving out on the working stroke, the spark occurs before the piston reaches the end of the compression stroke. This is called SPARK ADVANCE.

Q. How far is the spark advanced?

A. This depends upon the rate of combustion which in turn depends upon the quality of the mixture, the cooling system, piston speed and many other factors.

Q. Should the advance be greater at high speed than at low speed?

A. Yes. Because the combustion must be started earlier.

Q. Is there an adjustment for varying the advance?

A. Yes. The timing of the spark can be controlled either with a small "spark lever" by hand or automatically by means of a speed governor.

Q. Is the spark ever adjusted so that it occurs after the end of the compression stroke?

A. Yes. This is called a "retarded-spark" and is used in starting the engine or when it is turning over.

Q. Does the position of the spark much influence the running of the engine?

A. The engine runs faster and develops much more power with the spark advanced to the proper point than it does with the spark retarded. With the spark far retarded, the combustion is delayed, the mean effective pressure is reduced and there is a tendency toward overheating.

Q. How is the spark timed at the proper point in the stroke?

A. By a device known as a "timer" that is geared to the engine so that the spark will occur approximately at the end of the compression stroke. This can be rocked back and forth for a limited distance to get the proper advance or retard.

Q. What supplies the ignition current?

A. Either a magneto or a battery ignition system.

(*Concluded on page* 196)

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-20

Alkaline Battery. A battery employing an alkaline electrolyte or solution (caustic soda solution), such as the Edison storage battery. The voltage of such batteries is lower than that of the acid-lead type, but they are more rugged.

Allobar. A meteorological expression for an area undergoing changes of barometric pressure. An ANALLOBAR is an area over which the pressure is increasing while a KATALLOBAR is an area over which the barometric pressure is decreasing.

Alloy. A composition or mixture of a number of elemental metals. Thus, nickel, vanadium, chromium or tungsten can be mixed with steel to produce the "alloy steels." Brass is an alloy of copper, zinc and lead.

Allumage (French). Ignition or ignition system for internal combustion engine.

Alternating Current. An electric current that periodically reverses its direction of flow, passing through zero at the end of each reversal. This is distinguished from direct current that flows continuously in one direction.

Alternation. A single reversal of current in an alternating current. Two alternations, positive and negative, constitute a CYCLE.

Alternator. An electric generator (or magneto) that produces alternating current.

Altimeter. An instrument for measuring the height of aircraft above a given base. Generally, the altitude of an aircraft is given in terms of feet above sea-level.

Altimeter (aneroid type). An altimeter operated by the variation of air-pressure, the altitude being approximately proportional to the atmospheric pressure above sea-level.

Altimeter (sonic). A height measuring instrument based upon the time required for a sound wave to reach the earth and then be reflected back to the aircraft. This gives the height above earth or a body of water.

Altimeter (gravimetric). An altimeter that records the height of aircraft by the variation in gravitational pull on a known weight. The farther away from the earth, the less is the pull of gravity.

Altitude. (1) Height. (2) Usually understood to be the height of an aircraft above sea-level in feet.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-19

Alcohol (Amyl). An oily liquid called "fusel oil." Poisonous. Used for certain varnishes and lacquers.

Alcohol (Denatured). Ethyl alcohol to which certain agents have been added to make in undrinkable. Acetone, methyl alcohol, benzol and similar substances have been used as denaturants.

Alcohol (Ethyl). An alcohol obtained by the distillation of fermented grains such as cornmeal, rye, etc. It is the constituent of alcoholic beverages. Can be used as a fuel or a solvent.

Alcohol Fuel. Alcohol can be used as a fuel by burning it under a boiler or in the cylinders of an internal combustion engine, although it is too expensive for this purpose in its pure state. Mixed with gasoline, it retards detonations and permits a high compression pressure. Burns without forming residue.

Alcohol (Methyl). A raw alcohol prepared by the destructive distillation of woody fibers. Intensely poisonous. Used principally as a solvent.

Algebra. A mathematical science, frequently called "symbolic arithmetic" in which abstract symbols or letters can be employed for the representation of quantities.

Alighting-gear. See LANDING GEAR.

Align. To get a number of objects in line. To adjust bearings so that they will line up for carrying a shaft.

Alignment-charts. Charts for the solution of numerical problems, consisting of several parallel graduated scales which are read by placing a straight edge across them.

Aliped. Wing-footed like a bat.

Aliphatic Hydrocarbons. A group of petroleum hydrocarbons commonly known as the "paraffin series" or "saturated hydrocarbons."

Alkaline. Chemical classification for substances having the power to turn litmus paper blue and reacting with acids. Examples are: caustic soda, caustic potash, lime, ammonia, etc.

An Improved Course Indicator

by S. R. WINTERS

A new aid to avigation that gives a visual indication of an air-line course by a radio receiving system. It was developed by Wilbur S. Hinman, Jr., assisted by Harry Diamond, L. L. Hughes and G. H. Lester, all of the Bureau of Standards.

ANOTHER victory has been won by man in his tireless effort to conquer the air, by the development of a much needed instrument for determining direction and eliminating one of the chief hazards of night flying.

Ocean-going vessels have long since found the compass indispensable, and this new radio-compass is destined to play an equally important part in the operation of aircraft. Regular air routes are well marked by radio beacons for guiding air travellers, but the flyer on cross-country destinations has been handicapped by lack of directional facilities.

This new finder is bilateral and unidirectional, is adaptable for use with any receiving set, and gives visual indication of the air-line course. It is in the form of a loop-antenna, and, tersely expressed, is a "hank of wire and something to wrap it around."

It has for its object the guiding of passengers and mail-planes flying on other than the beaten path, and was developed by Wilbur S. Hinman, Jr., of the Radio Laboratory of the Bureau of Standards, who ascribes much assistance to Harry Diamond, L. L. Hughes, and G. H. Lester.

This direction-finder was installed on an airplane at College Park, Maryland, and actual flight tests were made by using the broadcasting stations of Washington and Maryland for location. The results were most gratifying, since the pilot was not familiar with the vicinities nor with the locations of the broadcasting stations and yet, from an approximate altitude of 3,000 feet, was able to determine within a half-mile radius the position of each station.

The accuracy of the finder has been determined as about 1 degree, it is almost entirely independent of static interference, it works on modulated or unmodulated radio waves, automatically phases currents, gives accurate indications and affords definite direction courses, has no moving parts and is not subject to mechanical failure, and, aside from tuning and volume control, requires no manipulation. All these features go to make this radio-compass of inestimable value to flyers.

The single-loop antenna direction-finder with radio receiver, installed for test.

The course-indicator for indicating the location of the course.

In the first experiments toward the development of this director, a regular Robinson direction-finder with two crossed loop-antennas was used, and a mechanical reversal of one loop-antenna with respect to the other by means of a rotating coil in a coupling system constituted the first model. This model was first tried by using a reversing switch simultaneously timed with the rotating coil, and then by using an electrical switch with two input and two output-tubes alternately connected and disconnected in pairs by sending alternating voltage to their grids.

While these experiments gave indications right and left of "course," they also brought in 90 degree courses, and the results obtained were far from acceptable. It was decided to experiment further, with a view to achieving more accurate indications and eliminating surplus mechanically moving parts.

The next model was adapted to alternately operate and cut off one loop-antenna by the use of a special output-switch, as shown in Figure 1. From this drawing it will be seen that the currents of the two loop-antennas are separated by four resistors, the two indicated by R_1 carrying the power of one loop-antenna to tube T_1 and the two marked R_2 transmitting to T_2.

By directing an alternating current to the grid of tube T_2, it was alter-

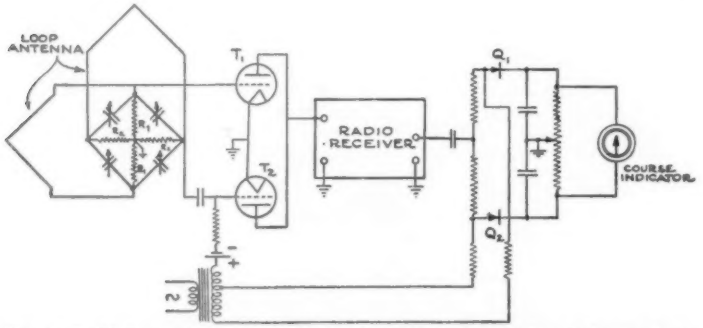


Fig. 1. Double-loop antenna direction-finder with modified Bellini-Tost bridge condenser tuning arrangement. The antenna system is attached to the input and the course indicator to the output of a conventional radio receiver.

nately connected and disconnected, so that the voltage transmitted to the radio receiver was alternately the voltage of one loop-antenna, and the sum or difference of the voltages of both loop-antennas. The output arrangement consisted of two copper-oxide rectifiers Q_1 and Q_2 arranged to send current through an attached zero-center course indicator in opposite directions, so that when equal alternating voltages opposite in phase were applied to the rectifiers equal and opposite currents passed through the indicator. As the loop-antenna voltages aided each other on one side of "course" and opposed on the other, right and left indications were achieved.

This model, having the important advantages of automatic phasing of currents and simultaneous tuning of the two loop-antennas, appeared very promising. However, unreliable courses were given when the voltage developed in one loop-antenna equalled the difference between that in both loop-antennas, and it was found that the false indications were not introduced by variations in the input-tubes but by differences in the relative power of the two currents.

While these errors were eliminated to some extent by the substitution of an aperiodic vertical antenna for one of the loop-antennas, the whole arrangement was considered unwieldy and was discarded.

Further experiments were conducted, resulting in the present single-loop method based on the principle of producing two equal but opposite distorted field patterns by reversing a loop-antenna dissymmetrical with ground. This was done by alternately grounding the loop-antenna ends through rectifier tubes and transmitting the voltage produced to a radio receiver by a radio wave.

The radio receiver outflow is applied to the rectifier tubes, and a zero-center course indicator is connected in such a manner as to ground one end of the loop-antenna, causing the indicator to turn to the right. When the other end of the loop-antenna is grounded the indicator swerves to the left.

The principle of operation of the present device is founded on the common practice of applying to a balanced loop antenna enough voltage from a vertical antenna to turn the regular figure-of-eight field arrangement of the loop antenna into a cardioid, which requires a vertical antenna current of

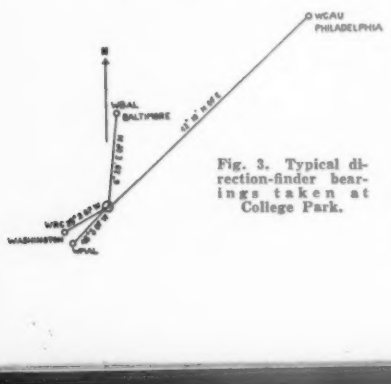


Fig. 3. Typical direction-finder bearings taken at College Park.

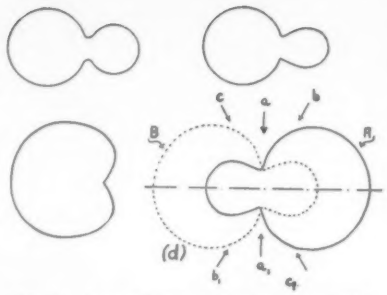


Fig. 2. Loop-antenna field patterns modified by a vertical component.

90 degrees out of phase with the loop antenna currents, or in phase with their resultant.

As a loop-antenna, dissymetrical with respect to ground, has a tendency to perform the function of a vertical antenna, the caridioid type of field pattern may be attained to some degree without the medium of a vertical antenna. On account of the vertical and loop-antenna effects, this arrangement necessitates sharp tuning of the loop-antenna if faultlessly phased patterns are required, for by such tuning the phases of the currents are exactly regulated.

Many different types of patterns may be produced, several being shown by Figure 2. The blunted minima is made by a phase angle between the vertical and loop-antenna effects. The rapid reversal of any of these field patterns, so that two equal patterns are produced alternately (as in d of Figure 2), with the zero-center course-indicating meter deflecting to the right proportionate to one field pattern and to the left proportionate to the other, results in bilateral indication of direction.

As each field pattern is symmetrical around the line representing the loop-antenna, it is readily seen that the two positions on the meter showing zero or "on course" are 180 degrees from each other and are at right angles to the loop-antenna plane.

The field pattern of the loop-antenna may be modified and reversed by grounding the loop-antenna ends through two rectifier tubes and applying alternating voltage, causing the passage of alternating current. The resistance of the rectifier through which the current flows is low, resulting in a satisfiactory ground at that end. By the resistance of the rectifiers tuning of the loop-antenna is secured, and the antenna effect is rendered somewhat aperiodic.

The course-indicating meter is so arranged in the cathode return-leads of the rectifier tubes that the rectifier currents run through it in opposite ways, giving a zero indication. The audio output of the direction finder is adjusted to the rectifier tubes in such a way that the currents resulting from this output-voltage are in proportion to the relative field patterns, and go through the meter in opposite directions. The course indicator then shows the differences in the voltages produced by the two field patterns, and gives bilateral reading of "course."

Figure 1 shows the circuit arrangement of this direction finder. Loop antenna L_1 is tuned by condenser C_1, and the voltage generated in the loop-antenna by received radio waves is passed to the first radio-frequency amplifier between the center point of the loop-antenna and ground. The ends of the loop-antenna are connected to rectifier tubes T_1 and T_2 by equal condensers C_3 and C_3. Alternating current of a frequency for despatch by the audio amplifier of the radio receiver is applied in opposite phase through radio-frequency inductors L_2 and L_3 to the rectifier tube plates.

The negative pole of each of the rectifier tubes is joined to one end of the resistor R_1, the adjustable center tap of which advances to ground through the radio output transformer of the radio receiver. Across the resistor the zero-center course-indicating meter M is hooked up, checked by high-capacity low-voltage electrolytic condenser C_5. The oscillating transformer O and the vacuum tube T_4, together with the tuning condenser C_4, furnish current to rectifiers T_1 and T_2.

To minimize any differences in the resistance of the rectifier tubes, R_4 may be introduced into the circuit, although its addition will lessen the sensitivity of the set.

The biasing resistors, R_3 and R_4, together with R_1, supply a grid return for T_3. Through the output transformer O_2 the radio receiver output is given to rectifier tubes T_1 and T_2, and this arrangement supplements their work of alternately grounding the loop-antenna ends by causing them to function also as an output switching unit. The application by the audio oscillator of a positive current to the plate T_3 gives a negative voltage to the plate T_2, resulting in T_1 using current when it has a low ground resistance and in disconnecting T_2 when it has a high ground resistance.

With the reversal of the voltage phase the action of T_1 and T_2 is the opposite, the grounding point of the loop antenna being reversed about its center point. In this manner rapid conversion of the loop antenna field is obtained and dissymmetry is secured by fixing the loop-antenna ends alternately at ground.

The audio oscillator voltage produces the currents of T_1 and T_2 which flow through the meter M contrariwise, and as the voltage is equally distributed to the rectifiers the currents are equal and the course indicator registers zero.

Two positions of the loop-antenna with respect to an incoming radio wave will produce "on course" readings, both at right angles to the loop antenna plane, 180 degrees apart. As shown by Figure 2(d), the reverse action of the course indicator produces an automatic sense of direction. The field patterns developed by the loop antenna

(*Concluded on page* 200)

Properties of Aviation Gas

by KEITH J. FANSHIER

A simple explanation of the technical details connected with the grading of gasoline, both for aeronautic and automobile engines.

SHALL aviation motor fuel be "anti-knocked" additionally? Does aviation gasoline require further treatment or superior refining in order to make it more efficient and more suitable for the ever-growing improvement of airplane engines?

That is the question which makers of gasoline for aviation will be called upon shortly to decide and it is likely that in the process of the decision there may be a miniature war. For, be it known, some interests want better gasoline, while others think present standards are well enough and still others believe present stiff requirements could be in some respects eased off a trifle.

The average aviation enthusiast may not know it, but the finest gasoline in all the world, bar none, any and all advertising claims to the contrary notwithstanding, are the types of gasoline which are furnished by certain oil companies to the fighting forces of the United States of America under the designation of U. S. Army specification gasolines—aviation, fighting, anti-knock.

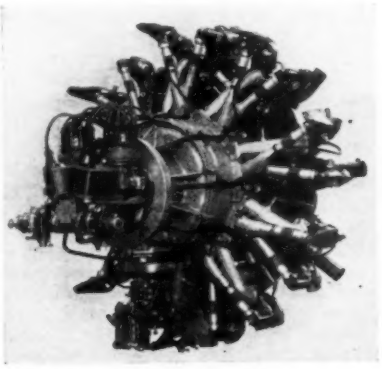
These gasolines are products, in the language of some advertisements, if it were offered to the general public, might be described as "super, super, super." They not only carry specifications which make them superior from the standpoint of quick-fire, clean-combustion and purity, but they also carry anti-knock rating which is nearly double that of some gasolines currently offered to motorists for use in automobiles.

Next down the ladder is what is known as Federal government specification gasoline, aviation, fighting. And the lowest grade of all aviation gasoline recognized in Federal specification is what is known as aviation gasoline—"domestic." Some of the specifications of these products have been changed rather recently and in view of the interest being stirred up over proposed changes, the writer thought that readers would like to have actual specifications in front of them to serve as a record in addition to the current interest attaching to them.

It might be said at the outset that whereas the aviation industry, the oil trade and the public alike talk largely of gasoline now in terms of its anti-knock quality, no Federal government specification of gasoline, with the sole exception of the one grade mentioned above, carries an anti-knock or "octane" specification. It is stated in aviation, fighting, anti-knock grade specification that this product must carry an octane number of 87.

First, let us consider what is known as domestic aviation gasoline. In case you wish to refer to it officially, you will find it as the product covered in Federal Specifications Board technical paper 323-B. The specification covers the grade of gasoline used by the United States government and its agencies where the fighting grade is not required.

First, it is required that the gasoline be free from water and suspended matter. This is a requirement generally made in all good grade gasolines. Standard rules are set forth as to methods of sampling in making tests. The government means to leave nothing to the imagination. Color requirement is provided. Method of testing to be used is that known as 10.11 and



The fastidious airplane engine requires the highest grade of gasoline.

the color must not be darker than No. 25 Saybolt. To the non-technical reader this may be described as a sparkling, brilliant product requirement.

What is known as a "doctor test also" is provided, using method "520.3" and requiring that the doctor test be negative. This aims to assure that quality has not been injured by treatment.

A corrosion test is required, method "530.1." One hundred c.c. of the gasoline shall cause no gray or black corrosion and the amount of deposit, when evaporated in a polished copper dish, shall not exceed 3 mg.

Most readers are familiar in a general way with distillation tests. Requirements as to distillation range aim to determine the efficiency and readiness with which the gasoline burns in the engine and are important from the standpoint of volatility. Using method "100.13," the temperature limits on the distillation range are as follows:

When 5 per cent. of the sample has been recovered in the graduated receiver, the thermometer shall not read more than 75 degrees C. (169 degrees F.), nor less than 50 degrees C. (122 degrees F.). The wording is aimed to deliver quick combustion of the light ends of the product and at the same time to provide a reasonable degree of safety from fire hazard; also to guarantee a certain amount of uniformity.

When 50 per cent. has been recovered in the receiver, the thermometer shall read not more than 105 degrees C. (221 F.); when 90 per cent. has been recovered, the thermometer shall read not more than 155 C. (311 F.); when 96 per cent. has been recovered, the thermometer shall read not more than 175 C. (347 F.); and the endpoint shall be not higher than 196 degrees C. (374 F.).

At least 96 per cent. shall be recovered as distillate in the receiver from distillation. The distillation loss shall not exceed 2 per cent. when the residue in the flask is cooled and added to the distillate in the receiver.

All along the line in the distillation range and in some other tests, the aviation gasoline requirements are more severe. For regular U. S. motor gasoline, the 10 per cent. figure is 167 F.; for 50 per cent., 284 F.; and for 90 per cent., 392 F. Formerly there was a 437 F. endpoint requirement for ordinary motor gasoline. Moreover, the government is more lenient with ordinary motor gasoline in the matter of the corrosion test.

Acidity and sulphur in a gasoline may be serious matters, particularly when used in aviation. In the domestic aviation gasoline specification it is required that acidity be tested by method "510.2" and that the residue remaining in the flask after distillation is completed shall not show an acid reaction. As to sulphur content, using method "520.11" the sulphur content shall be not more than one-tenth of one per cent.

It is provided in the specifications that any military branch of the government may require that samples be submitted for "approval tests" in addition to the laboratory tests.

So much for domestic aviation gasoline. But when it comes to qualities demanded in fighting aviation gasoline, the requirements become more difficult. It is officially stated that this specification, also contained in Federal Specifications Board technical paper No. 323-B, covers the grade of gasoline used by the government and its agencies as a fuel for fighting planes, where the highest efficiency is required.

Most of the "tightening up" in specifications are confined to the matter of the distillation test, which means that the fighting grade product is a much more volatile material. This is shown in the maximum temperature require-

ments at virtually all points on the distillation range.

When 5 per cent. of the sample has been recovered, the thermometer shall not read more than 65 degrees C. (149 F.). This compares with 167° F. in domestic aviation. When 50 per cent. has been recovered, the thermometer shall read not more than 95 degrees C. (203° F.). This compares with 221° F. in domestic aviation. When 90 per cent. has been recovered, the thermometer shall read not more than 125° C. (257 F.). This compares with 311° F. in domestic aviation. When 96 per cent. has been recovered, the thermometer shall read not more than 150° C. (302° F.). This compares with 347° F. in domestic aviation.

Finally, the endpoint shall be not higher than 160° C. (329° F.). This compares with 374° F. in domestic aviation. This endpoint is a more or less vital point, or in the past has been considered so in the petroleum industry. It is seen that fighting aviation gasoline is to reach an endpoint 45 degrees F. lower than domestic aviation, which means that at the endpoint it is to be perhaps 12 to 14 per cent. more volatile.

This is the famous "329" gasoline which is widely known by army pilots and others using it for purposes of good performance qualities.

From the standpoint of distillation range and a highly volatile gasoline, this is the most severe requirement set anywhere for gasoline outside unusual laboratory experimental purposes. Indeed, the distillation requirements are more exacting than those in fighting anti-knock aviation gasoline.

A great furore is now being witnessed in the petroleum industry and in some sections of aviation over the matter of getting rigorous anti-knock requirements into the domestic and fighting aviation products. As noted at the start of this article, anti-knock specifications are required in special anti-knock fighting grade, but they are not present in the specifications of the two products which have just been discussed. It was indicated some time ago that the government might be ready to step into the general motor fuel situation with a rigid anti-knock requirement on its various classifications, but up to date nothing has been done.

Of course, the oil industry is "anti-knock" crazy and "octane" crazy, and the automotive industry is much the same way. The tendency is toward increasing high compression pressures and supercharging in internal combustion engines still further and naturally this calls for motor fuels able to deliver power with a lack, or at least with a minimum, of knocking. How much farther this trend will go is uncertain, but as long as it is distinctly under way, it is not amiss to point out that the craze for high compression is re-

(*Concluded on page* 190)

Stainless Steel Boat Shows Long Service

Here is the stainless steel flying-boat that has led a long and varied career in America and in Europe.

THE first all steel airplane ever built, a four-place amphibian, is back in the United States after two years exhibition in Europe. It arrived at New York on the Roma from Italy, was lowered into the Hudson and a few minutes later was in the air, bound for Roosevelt Field.

The plane, property of the Edward G. Budd Manufacturing Company, of Philadelphia, was built three years ago to demonstrate the practicability of the shot-weld process of fabricating stainless steel. It was this process that made possible the building of the Burlington Zephyr, lightweight, streamlined train.

After a flight around the United States it was sent to Europe where it aroused the interest of the navies of several countries. Arriving in Italy it was flown from Genoa to Rome where it was demonstrated to Mussolini. From there it went to various Italian naval bases for study by naval engineers. As a result stainless steel was used in parts of the ship which Balbo flew to the United States at the head of a fleet of Italian planes last summer.

From Italy the plane was flown across the Alps to France where it was demonstrated to leading aircraft manufacturers and military and naval authorities. On several flights it was piloted by Gene Assolant, who won fame for his trans-Atlantic flight in the Yellow Bird.

Assolant flew it across the channel to England where it was demonstrated for the Royal Air Force. From England it was flown back to Italy, through Holland and Belgium, and has been in the service of the Savoia-Marchetti Company which has been licensed to manufacture the plane in Italy.

A Closeup of the Curtis F11C-3

WE HAVE obtained the excellent picture of the Curtiss single-seat fighter, known as the F11C-3, in full flight as shown herewith. It is powered with a 700 h.p. Wright Cyclone engine and with a retractable fuselage landing-gear that is out of the ordinary. This arrangement results in an unusually deep fuselage which, however, rather agrees with late developments in the Italian navy which feature this deep throated idea in many of their recent developments. A blunt entering mid-section offers little resistance.

The Curtiss F11C-3 fighter in flight with wheels fully retracted into the sides of the fuselage. It is powered with a 700 h.p. Wright Cyclone engine.

A Few Sidelights on Aviation

by LAWRENCE LESH

Scattered comments upon the development of aviation, its antiquity and lessons that can be drawn from historical lore.

THE present intense activity in Chinese aviation recalls the fact that China was undoubtedly the birthplace of the airplane and the parachute. The western march of progress has proceeded completely around the earth and apparently arrived near the starting point at the end of a 3,000 year cycle.

Bombing planes now thunder over the same rice fields where the Chinese kite, precursor of the airplane, was first seen in the sky and the very name FEI CH'O or "Flying Chariot" applied to the legendary Chinese machines for navigating the air is used today to describe the modern airplane.

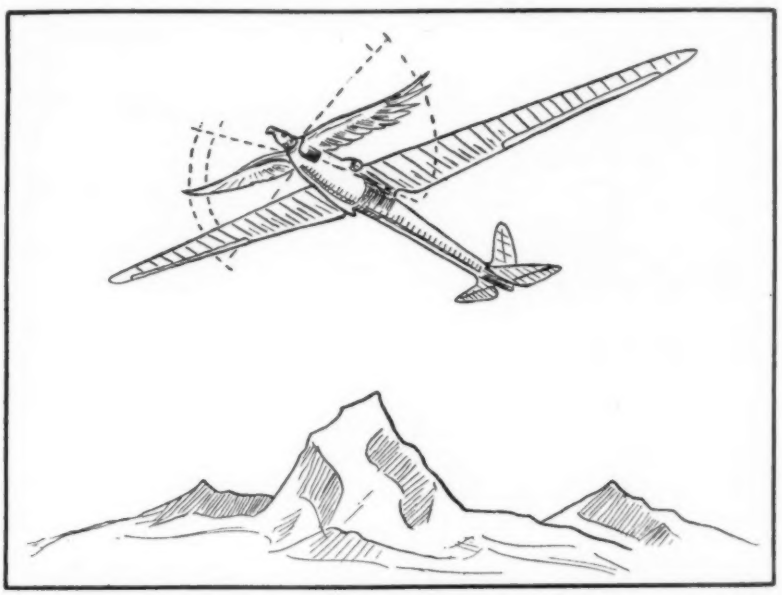
Many inventions and immortal "firsts" are properly credited to the Celestial Empire. Coinage was invented there about 1000 B.C. Paper was first used approximately 100 A.D. The compass and other instruments for navigation and astronomical study are variously credited to the Chinese. Even mirrors and materials which rendered visible the organs of the body are definitely recorded and may have been an anticipation of our modern "X" and infra-red rays used for the same purpose.

The historical development of aviation may be roughly divided into two periods—the speculative and the creative. Inventors and serious students are acquainted with and interested in the first period even where it extends back into legendary tales. Consciously or unconsciously they realize that the development of inventions and the solution of problems in the past points the way to probable events in the future and is worthy of study.

Engineers, however, particularly of the modern school, seldom extend themselves beyond the limits of their own slide-rule, text books and formulas. This contempt for the ancients sometimes brings a rude awakening when they find that their pet invention or idea cannot be patented on account of previous art dating back to early China or Greece.

Fortunately for future generations, the great engineers and scientists responsible for the final success of aerial navigation regarded it a part of their work and duty to make an exhaustive study of the early phases of speculative and experimental aeronautics and in massive volumes such as Astra Castra have handed the story down for posterity.

Considering the fact that aerial flight was ridiculed as an impossibility and coupled with perpetual motion until a comparatively few years ago by specially appointed government commissions as well as the general public, the prophetic vision which drove these pioneers to exhaustively record in book form the results of 3,000 years of effort to accomplish human flight, deserves more than the slight acclaim afforded today.



Here's a new suggestion, drawn from ancient Chinese history with a touch of the horse-and-buggy days. Just hitch up a Condor to your glider, feed him raw meat and away you go. But first catch your Condor.

The writer will not at this time attempt even a complete résumé of aviation history but will try to describe some of the more appealing facts and fancies in the hope that the reader may become sufficiently interested to follow up the subject with the assurance that there is a wealth of fascinating material on aeronautic history in every public library.

I will also depart from the usual historical formula by rather freely discussing the possibilities of some ancient aviation proposals in the light of present day knowledge in an attempt to show that these Early Early Birds thought up some schemes still worthy of a try out.

We must surely credit the earliest thought and work on aeronautics to the Chinese. Fortunately, their historians have recorded the invention of the kite, the parachute and in more fantastic vein, the mechanical dragons and other creations which constitute our starting point in the story of human flight.

Even the so-called imaginary concepts must be rated in terms of our modern understanding wherein we insist that if there is smoke there must be some fire and that pure imagination not based on actual experience cannot exist.

The first of many references to flight, by the ancient Chinese, records the adventures of Emperor Shun as a youth, whose span of life was from 2258 to 2208 B.C. Se-ma Ts'ien, the father of history, states that Shun was taught to fly by the two daughters of the Emperor Yao, whom he afterward married (both of them). This is something for the lady pilots of today to study over but the question still remains, who taught the princesses to fly in the first place?

Shun's flying equipment, described as "the work clothes of a bird," was principally useful in escapes from tough spots in which he was placed by his unappreciative father. Thus, he escaped from a granary roof when the old man set fire to the lower part and on this, or a similar occasion, made his get-away with the aid of two very large reed hats which he used as a parachute.

These hats, probably the same sort as the enormous umbrella-like creations still used in Korea, might be reasonably credited with serving the purpose and so we are inclined to ad-

mit that Shun not only may have been the first aviator but that he also built and tested the first parachute—3,000 years ago.

The earliest reference to a "flying chariot" (present Chinese name for airplane) seems to take us back to 1766-54 B.C. at about the time of the founding of the Shang dynasty. Ki-kung-shi built a flying chariot shown in later prints of doubtful veracity as driven by two multi-bladed propellers.

It could only go in the direction of the wind, but made a long flight to Ho-man, where the emperor caused it to be destroyed, probably on account of violation of rules and regulations of his department of commerce in the manner so familiar to us at the present time.

Ten years later, when the wind was blowing favorably for a return trip, the emperor permitted Ki-kung to build a new ship and fly home. Ki-kung probably spent the ten years raising funds for a stress analysis to prove to the Chinese D. C. that the ship would fly.

In the Book of Mountains and Seas, an ancient and doubtful collection of stories, "Ki-kung" is given as the name of a race of one-armed three-eyed hermaphrodites riding on striped horses but there is no evidence that the real Ki-kung belonged to this weird outfit. Amateur aviators are often subjected to abuse and called names but even in ancient China I question that their critics or the authorities would go so far as to call one of the noted amateurs a "one-armed three-eyed hermaphrodite."

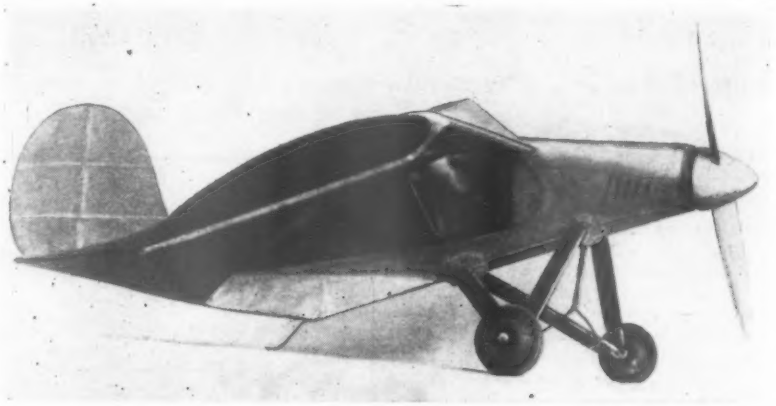
The story of Ki-kung's flight hints strongly that the principle of the kite was employed. Now, there were only two ways known to the ancient Chinese for mechanically propelling a vehicle: the kite and sails, both used up to the present time even for pulling wheelbarrows. Kites achieved an amazing development in China, so remarkable that Octave Chanute predicted in 1894 that the stable airplane of the future would probably find its prototype in a Chinese kite. During my acquaintance with Chanute from 1905 until his death in 1910, this grand old man of aviation constantly pointed out the importance of the Chinese bird kites as a foundation for airplane design.

We might reconstruct the machine of Ki-kung and other similar flying chariots described in Chinese history as always going with the wind, somewhat along the following lines:

Ki-kung probably built kites of increasing size and found that they would tow light wheeled vehicles rapidly over the ground and would possibly also small boats through the water. It is conceivable that he might have tried a boat which was itself equipped with sails and I might then add the following suggestion based on

(*Concluded on page* 186)

The Clawson Kite-Plane Flies Well

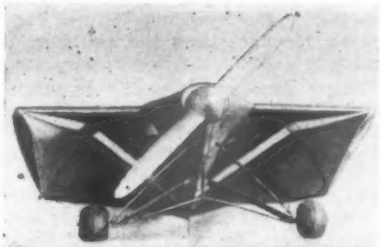


Side elevation of the Clawson airplane model showing the profile of the wings.

SEVERE and exhaustive tests with models of this kite plane have proved so satisfactory that a full sized machine will soon be constructed by the inventor, Mr. L. F. Clawson, La Mesa, California.

A striking feature of this remarkable advance in airplane design is the introduction of slots between fuselage and wings. By this means the lift is greatly augmented and the airflow over wings made secure from breakdown. This, of course, gives far greater control at all speeds and also the maximum lift from wing area.

The inventor claims that this machine, being more compact and of simple design, will be both stronger and more efficient than the conventional light plane. Having only a fourteen-foot wing spread, it can be housed in small space.



Front elevation showing wing slots, and span curvature.

I.E.S. Discusses the Future of Aviation

THE seemingly fantastic of today may become the reality of tomorrow, and it little behooves any of us to laugh at what may seem aeronautical absurdities, says Professor Alexander Klemin, director of the Guggenheim School of Aeronautics of New York University.

At a meeting of the Institute of Aeronautical Sciences in New York recently, Professor Klemin discussed some of the novel attempts being made in airplane design to solve the problem of quick take-off with short run, and sounded the warning that designers must not discard the bizarre without careful study.

In outlining airplane "dream children" which warrant consideration, he mentioned the monobiplane, the telescopic wing, which extrudes sections at its outer edges to increase lift; the biplane using the slip stream of two engines with extra large propellers to give lift at high angles of attack, and the tilting wing, also benefitting from the slip stream.

Along this line, the aeronautical section of the American Association for the Advancement of Science, at its convention in Berkeley, Cal., was told that airplanes having neither wings nor screw propellers may be developed. F. K. Kirksen, professor of aeronautical engineering at the University of Washington, said this prospect is supported by principles of air mechanics already developed in Europe and the United States and is of proven practical value.

The essential feature of this new type aircraft resembles the ferry boat propelled with paddle wheels. Air instead of water would constitute its ocean.

In describing the characteristics of cycloidal aircraft, Professor Kirksten said:

"Idling cycloidal propellers should be superior to fixed wings in standard gliders of airplane form. Cycloidal aircraft offer advantages for military duty in that there are no wings to obstruct the view or to interfere with machine guns.

"The cycloidal propeller has the important advantage of being noiseless. There seems to be no reason why the type cannot excel the airplane in any maneuver now performed."

It is just possible that these improvements will be undertaken in the near future. There are many patents on each idea.

Kinner's Folding Wing Plane

by LOU HEAD

One of the latest inventions of W. B. Kinner which greatly reduces hangar space and yet a design which makes the folding wing principle perfectly safe from a structural point of view.

RECENTLY there has been introduced into aviation the first practical folding wing airplane, the result of years of study and invention by W. B. ("Bert") Kinner.

Kinner patented his wing in May, 1933. Last Summer he opened a factory and after putting out three rigid-wing planes, called "Airsters", he completed his first folding wing Airster. With the incorporation of the folding wing in his plane specifications, Kinner can now bring the ship's span down from forty feet to thirteen feet.

Think what this means to the boys who have to dig deep each month for hangar rent at airports, the average charge throughout the States being $1 per span foot. From $40 down to $13 is a nice reduction! This invention is really practical too. No disassembly, no tools required, no machinery needed. Like all practical mechanical improvements, the folding wing is the personification of simplification.

Taking his standard Airster, Kinner simply set the front fuselage wing strut fitting at a 45 degree angle. He then placed a hinged fitting near the trailing edge of the wing just outside of the wheel strut where the wing would "break" for folding. This fitting was set at a thirty-seven degree angle. At the leading edge of the stationary wing portion a thirteen inch compartment was cut, covered with a metal curved door. In this he placed a screw-bolt which fitted in an anchor slot on the cross-section of the folding wing. The bolt was fitted with a turnable handle.

Here's how it works. In comes the pilot. He taxies across the field to the hangar door. Cuts his motor, jumps out, strides around to one side of the motor mount. He next flips open a metal compartment cover, which has been secured with a steel cotter pin; pulling out the turnable handle, he quickly screws out the anchor bolt. Then taking the wing by the end grip he walks towards the tail.

The wings are now folded back along the fuselage.

The Kinner folding wing in which (1) is the detachable wing connection and (2) is the strut socket.

When folded straight backwards, he secures the wing to the tail assembly by a steel rod which was stored within the wing compartment. The wing, as it moves backward, also folds up *flat* against the fuselage side, thus procuring two movements in one and conquering the problem which for so long has baffled aviation engineers whose best effort heretofore was a wing that folded back in only one position—laterally. In this wing, no struts are changed and only one bolt in the wing is displaced. It took the pilot just *three* minutes to complete the operation on *both* wings.

The really important part of Kinner's wing is the arrangement of the two hinged strut fittings so that when the wing is folded the struts, at no time, change their relation to the wing.

When closed and anchored, the wings bear the same specifications as the ones on the rigid wing plane. The compartment door, when closed on the turnable bolt handle, guards against mistakes, since it can't be closed unless the bolt is screwed into place and the handle is folded down into flying position.

The ship, itself is powered with a 100 horsepower five-cylinder engine with a Story prop. A hinged motor mount is used, permitting free inspection and service of the rear assembly by removal of but two bolts. Fuel and control connections hinge with the mount. The wings are supported by double spruce spars, routed to reduce weight without lessening strength. Area including ailerons, is 240 square feet with streamlined wing struts.

The fuselage is of welded chrome-molybdenum steel tubing. The cockpit provides for side by side seating with parachute type of seat and entry doors on each side with military type of windshield. The pit is thirty-seven inches wide.

The plane's dimensions are: span, forty feet; chord, 7 feet; length, twenty-three feet; empty weight, 1225 pounds; pay load capacity, 550 pounds. The high speed is 100 miles per hour and a landing speed of thirty-five.

The folding wing may be destined to become exceedingly popular.

Showing the lower fitting (1) disconnected.

Wiley Post's Airtight Suit

Wiley Post looks more like a deep-sea diver than a pilot.

A NEW stratospheric flyer has come to light in the person of Wiley Post, doughty Oklahoma globe circler.

Mr. Post has set himself the goal of a round-trip, dawn-to-dusk flight, between New York City and Los Angeles, just as a means of polishing up for his competition flight in the Sir MacPherson Robertson London-to-Australia, winner-take-all race, next October. This announcement came from officials of the B. F. Goodrich Company, who have made a special rubber flying suit for Post.

When he climbs into the Winnie Mae for the dawn-to-dusk round trip attempt, he will look more like a deep sea diver than a pilot. He will be sealed into this special suit which the Goodrich Company has prepared especially for his high altitude work. The suit is in two sections with the pants coming well up over the waist line. The shirt overlaps them, and is attached to a glass and duralumin helmet. A metal ring at the waist can be drawn tight with a wing nut, sealing the two parts together.

The same compressor which supplies air to the engine will force fresh air into the suit. Provision is made for expelling the breathed air and automatic adjustment of the pressure is arranged for as soon as it reaches a point higher than that encountered on the earth.

Oxygen can be valved into the suit.

He has announced he will fly in the rarified air of the stratosphere, and that he expects the Winnie Mae to push through at 350 miles an hour, making it possible to hop back and forth across the United States in 14 or 15 hours.

Utilizing the same advantage from stratosphere flying on the MacRobertson derby, Post hopes to be able to outdistance his competitors by a considerable margin.

A Japanese Reader's Dream Ship Is Entered

WHETHER this dreamship originated in the strains of the "Japanese Sandman" will probably never be known, but our friend Masaaki Kawaguchi evidently had pleasant dreams before this ship was laid out on paper. He attaches the insignia "Made in Japan."

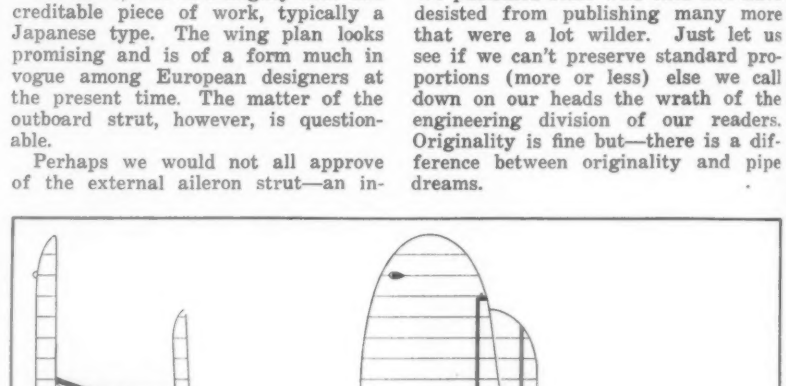
The designer attaches great confidence in this ship, which perhaps is well justified. It is a pursuit type, all-metal covered, and is provided with four machine guns. The engine is an air-cooled Jupiter (quoted at 500 h.p.) which, it is hoped, will push the biplane along at the merry rate of 205 m.p.h. top speed and which will land at 60 m.p.h.

All in all, this is a mighty neat and creditable piece of work, typically a Japanese type. The wing plan looks promising and is of a form much in vogue among European designers at the present time. The matter of the outboard strut, however, is questionable.

Perhaps we would not all approve of the external aileron strut—an internal mechanism would be better on a plane of this type—but that is a matter of small moment. Again, greater steadiness in diving could be achieved by giving sweep-back to one of the wings as in the Curtiss Hawks and the Hawker "Fury."

But, to digress a bit, we wish to announce the return of the "Dream Ship" feature of P.A. that has proved so popular. We have been besieged by ambitious readers who continue to send in their sketches regardless of whether we are running a Dream Ship department or not, so we will bow our heads to the demand.

But, in return, we will ask you to please keep your designs within reason. We published some wild ones and have desisted from publishing many more that were a lot wilder. Just let us see if we can't preserve standard proportions (more or less) else we call down on our heads the wrath of the engineering division of our readers. Originality is fine but—there is a difference between originality and pipe dreams.



THE KAWAGUCHI FIGHTING DREAM SHIP

What About the Span-Loading

by WALTER H. KORFF

Span-loading is a point generally overlooked by the amateur designer, yet it is of importance in certain features of the performance, notably, climb and ceiling.

AFTER making a study of the characteristics of a number of home-built lightplanes, the writer has found that they were decidedly lacking in climb and ceiling performance due to the fact that the builders knew nothing of induced drag, span loading, etc.

These builders were sadly disappointed and then came to the erroneous conclusion that the engine was not powerful enough to do the work. Had they used a larger wing span, the results would have been different for a long span is an absolute necessity if climb and ceiling are to be at par.

It may be definitely stated that from 20 to 25 h.p. is sufficient for a single-seater and from 30 to 35 h.p. for a two-seater lightplane. That is, this power is ample providing that the span of the wings is great enough. The truth of this statement is proved by the record breaking performance of the Aeronca of 30 to 35 h.p. or the Aeromarine-Klemm two-seater with only 20 h.p. In Table I, I give the performance of these two remarkable planes.

Of course, span is not the only important feature of lightplane design, but it is certainly of sufficient importance to attract more attention than it has heretofore. The span, or span-loading as it will be hereinafter referred to, is important for the following conditions of service:

1. Good climbing angle.
2. Time to reach a given altitude, generally 5,000 feet.
3. Ceiling.

The unit, "span-loading," is equal to the load carried in pounds per running foot of span. For example: A 600 pound airplane with a 30 foot span has a span loading of, 600/30=20. To a certain degree this is an independent function but from another angle it involves the matter of aspect ratio, in a more convenient form. Instead of saying that a certain lightplane is underpowered, it is usually more nearly correct to say that is "Under-spanned".

And then you ask, "Why does span increase the performance?" The answer to this question is, "Because it reduces the induced drag." The induced drag, in this case, may be defined as the effect of downwash by the wing. Its effect can be observed by noting the action of a fine thread attached to the trailing edge of a model. Due to the downwash of the air, the thread will make a much greater angle with the air-stream than the wing itself. In short, in level flight, the wing must climb at the same angle as that of the angle of downwash.

When the span is increased, the power required to overcome the induced drag is decreased. This statement is based upon the theories of Dr. Prandtl and has been proved by experiment. Quantitatively, this is also a function of the type of wing section—particularly of its maximum wing coefficient.

Generally speaking, a lightplane is considered to have sufficient performance in the way of climb and ceiling if the ceiling is in the neighborhood of 15,000 feet or more. With that idea in mind, Table II is prepared which shows the correct span loading to use for a ceiling of 15,000 feet when the power loading is known. The power-loading is equal to the total weight of the ship divided by its actual applied horsepower, hence a 600 pound plane equipped with a 25 h.p. engine, will have a power-loading of: 600/25= 600/25=24 pounds per horsepower.

The above table is close enough for all practical purposes but should be checked up with some successful and unsuccessful planes that you know. It should be noted that, as the power-loading increases by the same amount (2.5), the span loading decreases at a much lower rate. In other words, if the horsepower is small, then the span must be correspondingly great if the proper ceiling and climb are to be obtained.

For those who have already built their plane and are not satisfied with the climb or ceiling, it is suggested that the span may be increased by the addition of a center section. But, if the wings must be entirely rebuilt, remember that it is possible to salvage about everything with the exception of the covering.

The reader may wonder why wing-loading and aspect ratio were not mentioned. And here is the answer. Wing-loading, or the load per square foot of wing surface, only affects the landing speed and the take-off. It has nothing to do with the climbing rate or ceiling except indirectly. Excessive wing area, or excessively low wing-loading, may slightly reduce the climb and ceiling due to the additional drag imposed by the large wings.

Aspect ratio is useful in the wind-tunnel for direct comparisons under equal conditions of span and chord of various wing sections, but in computations of climb and ceiling, span-loading and power-loading are the decisive factors and not aspect ratio.

When we get right down to the bottom of the matter, the additional climb and ceiling attained by the proper span-loading is due to a greatly improved power reserve. Less power is then required for carrying the weight of the plane at a given speed, hence more power is then available for climbing because the power for climb is equal to the net engine power less the power required for normal horizontal flight at that speed.

In the actual design, we first look into the matter of wing-loading to attain the required landing and take-off speed. The wing-loading is the load carried in pounds per square foot of wing surface and is comparatively easy to determine, either by calculation or by checking up against the loadings and landing speeds of existing planes.

After the wing loading has been determined upon, the proportions of the wing can then be arranged so as to attain the most favorable span loading. In short, the span and chord must be adjusted so as to give the most effective span-loading with the required wing area. However, care must be taken so that the span is not made unduly great with a correspondingly small chord, since such proportions will lead to structural difficulties or weak wings.

In conclusion it may be said that the span should be as great as possible within practical limits, and any increase in span that is made to an existing airplane always shows improvement in this side of the performance.

TABLE I. LIGHTPLANE PERFORMANCE DATA

Manufacturer	Model	Span	H.P.	Weight	Seat	Ceiling	Span Load	Power Load
Aeromarine Klemm	AKL-20	42'7½"	20	1058	2	15,000	24.77	52.9
Aeromarine Klemm	AKL-25	42'7½"	40	1102	2	18,000	25.77	33.1
Aeronca	C-2	36'0"	30	700	1	16,000	19.44	26.9
Aeronca	C-3	36'0"	40	875	2	12,000	24.30	25.0

The ceiling for the Aeronca is the service ceiling when the plane is climbing at the rate of 100 feet per minute. The absolute ceiling is therefore much higher.

TABLE II. SPAN LOADING FOR 15,000 FOOT CEILING

Span-Load Lbs./Ft.	*Power-Load Lbs./H.P.*
35	15.0
31	17.5
27	20.0
25	22.5
23	25.0
22	27.5
21	30.0
20.5	32.5
20	35.0

Flying Wing and the Vortex Theory

by RAOUL J. HOFFMAN

FROM hydrodynamic theories, we have assumed that the energy absorbed by the wing tip vortices is equal to the work to overcome the induced drag. There are two distinct vortices concerned: the trailing edge vortices and the wing tip vortices.

The trailing edge vortices are pulsating cyclic motions and their frequency may be estimated. The eddies are not superimposed as shown in some publications but are staggered and it is obvious that the minimum resistance of a wing of streamline section will not be at zero degree. The axes of the trailing edge vortices are perpendicular to the line of flight.

The wing tip vortices have a continuous cyclic motion, creating swirls with their axes parallel to the line of flight. To reduce wing tip vortices, the wing tips are rounded and, especially in lower aspect-ratio wings, their efficiency is thereby increased considerably. This again brings us the tapared wing.

The designing and building of the first flying-wing, the ARUP, based on wind-tunnel tests made by the writer, has shown the error of the general assumption that lowering the aspect-ratio will cause a reduction in maximum lift. This has been proved by the N. A. C. A. report No. 431.

An explanation may be found in the interference of the two main vortices, which may reach a maximum at an aspect-ratio of 2 to 3 where the turbulency must be the greatest, depending on the design of the outline of the flying wing and the wing-sections used.

By lowering the aspect-ratio, the trailing edge vortices totally disappear and the wing tip vortices—which have a perfect cyclic motion—become prevalent. Two or more spirals with their axes are parallel to the line of flight.

Reducing the aspect-ratio increases the dynamic stability of the flow, thus increasing the maximum angle possible and also increasing the maximum lift about 80 to 100 percent found with an aspect-ratio 6. It could be shown that the high aspect-ratio would be of an advantage for low speed ratio airplane and the low aspect-ratio for high speed ratio wings, having the same landing speed.

The high-lift could only be obtained by a smooth unhindered flow of the circular motions of the air-stream. Test with the flying-wing has shown that the introduction of disturbing elements —the landing angle of attack at 20 to 23 degrees—the maximum lift will be destroyed and may be lower than the one obtained in a conventional wing. The highly disturbed airflow will find an easy escape from under the lower surface of the wing.

A great number of flying wings had been built with more or less success, but the added body and tail group disturbed the cyclic flow of the vortices.

The thickening of the wing—and the added body—reduces the maximum gliding angle by 5 to 10 percent, so long as the body has been designed integral with the median line of the wing. The added body diverges the flow towards the tip of the wing and to counteract the centrifugal tendency of the flow, a negative dihedral of the lateral median line will be used; thus creating a parallel flow of the vortice axes.

These vortices should have the characteristics of swirls dying out as they leave the wings, the top and bottom and meeting at the trailing-edge.

This seems to be the basic design in nature, except that one part of the leading-edge has a forward sweep, meeting the air-stream normal to the divergency line and the other part of the leading edge has a positive sweep or sweep-back and a drooping median line thus creating swirls.

The above mentioned conception of the low aspect-ratio flying wing will have a decidedly new influence on the design of future airplanes.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-21

Alto-cumulus (A.Cu.). Dense white or grayish fleecy clouds with shaded portions, ball shaped, usually arranged in flocks or rows. Sometimes so close together that their edges meet.

Alto-nimbus. High nimbus. A dull colored cloud which, when carried by an aircurrent beneath a cumulus cloud, frequently leads to rain.

Alto-stratus (A.S.). Clouds forming a thick gray or bluish veil.

Alula. The false wing of a bird (ala spuria).

Aluminium. The old and chemically correct name for ALUMINUM. Used in the French and German languages.

Aluminum. A soft light white elemental metal (Al), weak and useless commercially in its pure state but capable of being alloyed with other metals to form structural material for aircraft.

Aluminum Alloy. An alloy containing aluminum such as duralumin, aluminum-bronze, magnalium, etc. These are light weight alloys commonly employed in aircraft.

Aluminum Bronze. A light non-ferrous alloy consisting mostly of copper and aluminum. Resists corrosion and takes a beautiful polish.

Aluminum-grease. A solid or semi-solid lubricating grease in which the basic material is aluminum stearate. Lubricating oil is mixed in with the stearate to the required amount for a given consistency. Often called "castor machine oil."

Aluminothermic Welding. Welding by pouring molten steel into the joints. The steel is produced by using aluminum as a fuel, the oxygen for the combustion being provided by iron oxide scales.

Amerissage (French). A landing made on the sea.

Ambroin. A solid plastic material made by the combination of fossil copal resins and silicates. It is an excellent insulator and can be molded into various shapes.

Ambroin Cement. A cement formerly made from fossil resin dissolved in a suitable solvent (amyl acetate), but at the present time is made from a great variety of gums and resins.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-22

Ammeter. An instrument for measuring the rate of electrical current flow in AMPERES.

Ammonia. A colorless pungent gas composed of nitrogen and hydrogen. (NH_3).

Ammonia (Aqua). Solution of ammonia gas in water. A strong caustic alkali. Will dissolve most fatty oils and greases.

Amp. Abbreviation for AMPERE.

Ampere. The rate of electrical flow or the unit of current.

Amperehour. The electrical work done by a current of one ampere flowing for one hour. This unit is used for specifying the capacity of storage batteries. Thus, a battery having the ability to provide 60 amperehours from fully charged to discharged condition, can supply one ampere for 60 hours, 2 amperes for 30 hours, and so on.

Amphibian. An airplane provided with both a float and landing wheels so that it can take off or land on earth or water.

Amphibion. A trade word adopted by Sikorsky for his line of combined land-and-water aircraft.

Amplifier. A device for increasing or augmenting a feeble electrical current. Used for increasing the signal strength on a radio receiver, or for boosting up the original weak signal to greater audibility.

Amplitude. (1) The distance covered by a swinging body. (2) The height of a wave system measured on a graph.

Amsler Planimeter. An instrument used for measuring the area of irregular figures, for determining the center of gravity, moment of inertia, etc., directly and without calculation. It is also called a "mechanical integrator."

Amyl-acetate. Commonly called "banana oil" because of its odor. It is a liquid solvent for many gums and resins, celluloid, etc. It is also a solvent for lacquers and is used with aluminum paint.

The Caproni School Bomber

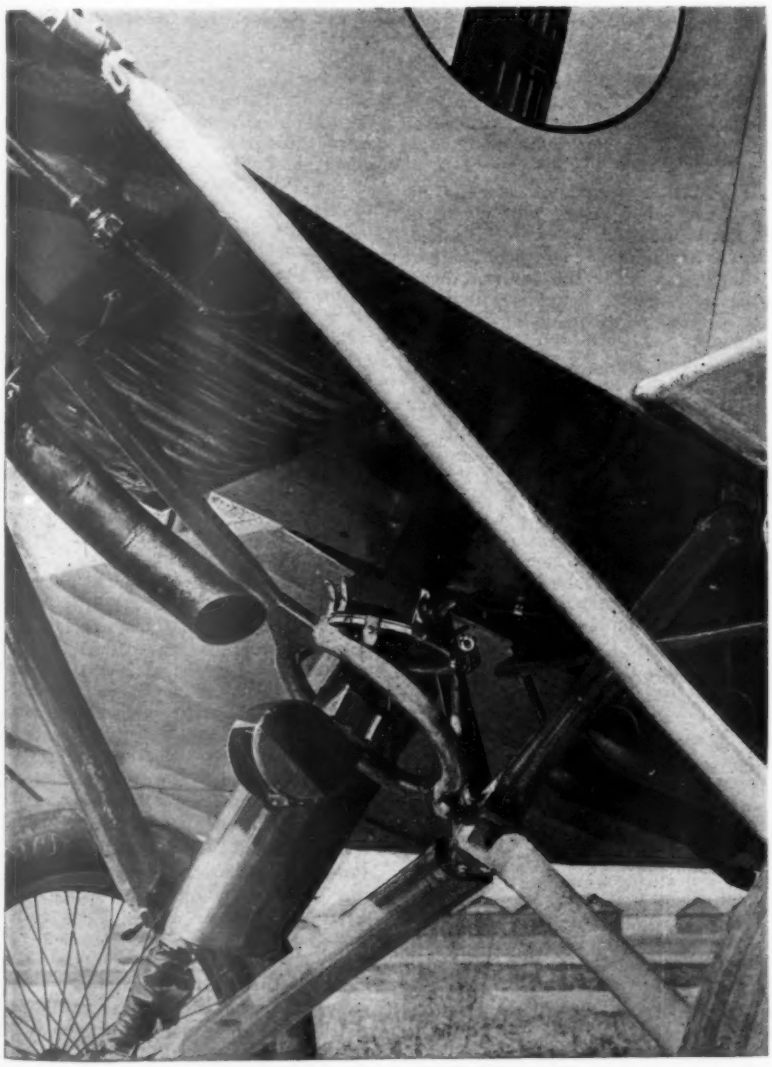
by CARLOS DERHYSKY

This training bomber employed by the Italian Air Service greatly decreases the cost of student bombing practice. It is the latest development in trainers.

BOMBARDMENT practice with heavy bombs is exceedingly expensive, and in cases where the exercises are more for the purpose of ascertaining the results of the training than for bombing practice itself, the great expense is unwarranted.

Again, simply flying the large bombing planes without considering the cost of the bombs, is quite expensive because of the great amount of fuel consumed and the depreciation of the planes and engines in flight, to say nothing of huge losses in the case of crackups. This has, therefore, resulted in the development of a small Italian training bomber which is comparatively inexpensive to maintain.

Front view of the Caproni light-bomber and trainer.



Details of the bomb racks on the latest Caproni bombing trainer.

This small Italian training bomber is a short span biplane of wood construction, fitted with a 130 h.p. engine and has a top speed of approximately 120 m.p.h. In short, it is a new edition of the Caproni "100" lightplane, stronger and more powerful, that has been adopted by nearly all the training departments of the Italian Royal Aero Clubs. It is a two-seater with the seats in tandem and with single controls.

It carries, under the front section of the fuselage, four 24-pound bombs, these bombs being released by controls in the front seat. A special "Joza" aiming device built by the Ottico Meccanica Italiana, corrects for speed and altitude when the bombs are released. The bombs can be released singly or together so that perfect practice can be had, as in the full size bomber, yet at comparatively small expense for fuel and upkeep.

Looking at the front of this plane we see a rather unusual wing construction. It is a biplane with reversed overhang, that is, the span of the lower wing is greater than that of the top wing. The limited area of the wings is thus made more effective for slow landings as greater account is taken of the ground cushion effect.

Again, a very pronounced dihedral is given to both wings which undoubtedly gives a steadier "gun-platform for the dropping of bombs. It will also be noted that the struts are inclined in such a way that very short lift-wires are possible and so that the lift wires make a good angle with the wings, thus reducing the stresses. This is one advantage of the inverted wing assembly.

Very great care has been taken in the designing of the bomb-racks in respect to parasitic resistance.

Our readers will be interested to know that Guiseppe Caproni has been a personal subscriber to POPULAR AVIATION *for years.*

Building the Epps Lightplane

by MANLEY MILLS

This is the second installment of the series of lightplane construction articles. The first article appeared in the August issue of P.A.

MAKE the internal brace wire fittings from 16 ga. steel. 36 will be required, 20 of which are of the single type to be used at the end ribs. The fittings are fastened to the spars with ¼ in. bolts after the wing is assembled.

The aileron hinges are of 16 ga. parts, exactly alike, joined together with a ¼ x 19/32 in. clevis pin, and fastened to the spars with ¼ in. aircraft (nickel steel) bolts. A 1 in. diameter washer of 16 ga. material is placed under the nut of each bolt to protect the spar. Plenty of care must be exercised in making and assembling these hinges, for they must work freely in any position without binding.

The aileron horn is composed of two parts welded together. As indicated in the plans, the front and rear edges of the two parts are bent to form a sort of streamline section when the halves are welded together. Fasten the horn to the aileron rib and spar with 3/16 in bolts. A ball-and-socket joint is used at the ends of the tube connecting the horn with the bell-crank in the wing.

At the upper end of the horn, a hole is drilled to fit an auto steering-gear drag-link ball, and a collar, made from a section of 16 ga. tube, is welded over the hole. Several makes of aircraft use the ball-and-socket type of joints in the control system, so if you happen to live near a busy airport, you may be able to locate some parts of this nature suitable for your own controls. However, the automobile type is perfectly satisfactory. If you don't want to use the ball-and-socket joints, it would be all right to employ 16 ga. sheet metal universal couplings of the type used at the control-stick end of the aileron push-pull tubes.

Each "N" strut fitting consists of two parts, both of which are made of 14 ga. steel. The main part wraps around the spar and has two lugs which provide an anchorage for the flying or landing wires. The other part carries the "N" strut lugs and is fastened on by two of the same bolts which hold the main part.

Front view of the Epps lightplane with a Gipsy engine installed. Note the simplicity of the interplane bracing.

The center-section attachment fittings are simply 1 in. wide straps of 14 ga. steel which go over the top of the spars. The upper bolt holding these fittings also holds the internal brace wire lugs, though for clarity they are not shown in the drawing of these fittings.

Though the aileron bell-cranks and brackets are really part of the control system, they will be described at this time since they are a part of the internal wing structure too. The arms of the cranks, instead of being at right angles to each other, form an angle of 82 degrees. In other words, the arms connected to the control stick will diverge away from each other when the system is assembled. The reason for this arrangement will be apparent to anyone familiar with airplane control principles.

You remember, on account of the disturbed air over the top surface of a wing, an aileron's effectiveness is reduced. To equalize the pressure on the ailerons, the one "going up" should move through a greater arc than the other one. That's the "raison d'etre" of the diverging bell-crank arms; they provide a differential action on the same principle as the steering gear of an automobile, which in the latter case, causes the inner wheel to turn sharper to prevent skidding when rounding a curve.

The control-stick arm of the bell-cranks has a ⅝ in. offset so the push-pull tube will clear the truss members of the ribs.

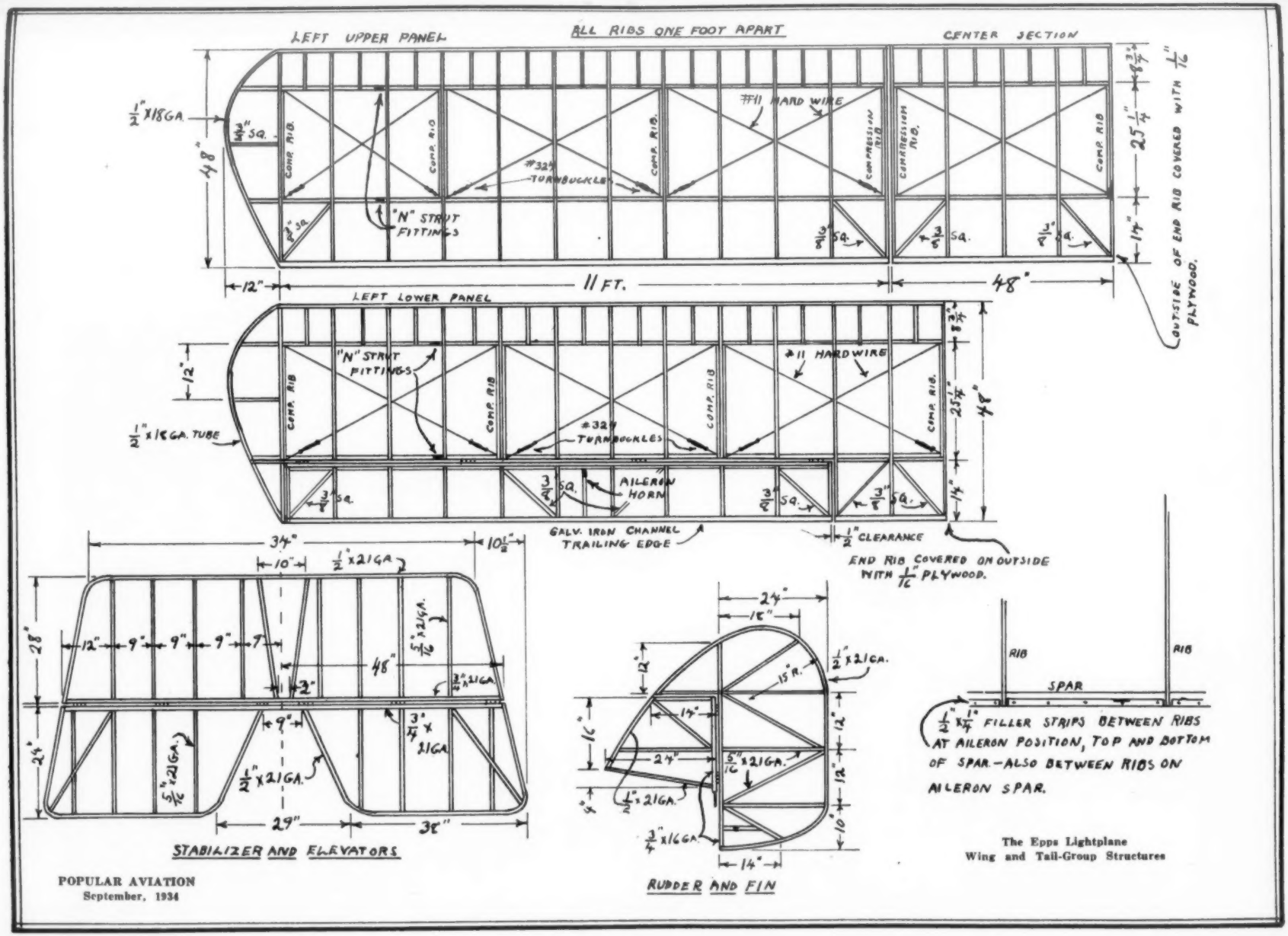
Make the bell-crank brackets from 14 ga. steel. The reinforcing plate is welded in after the bracket is bent to shape, thus forming a rigid assembly. Incidentally, a couple of ⅛ in. dia. oil holes should be drilled in the bell-crank bearing tubes.

Galvanized sheet iron of 22 ga., bent to a "V" or channel shape, is used for the trailing edges. The reason for using galvanized iron instead of aluminum or other metal is that it can be easily soldered to the clips which hold it to the ribs, and it is inexpensive.

The wing tips are of ½ in x 18 ga. tubing. The end of the tube is fastened to the leading edge by flattening it and attaching with a wood screw. To make a neat, smooth joint, the end of the tube should be set in a recess cut in the leading edge and then covered with a strap of copper or galvanized iron, soldered to the tube and tacked to the leading edge and ribbon. In the same manner, the tube is fastened to the ends of the spars, though it is not flattened at these points, of course. At the trailing edge, the tube is flat-

(*Concluded on page* 188)

Three-quarters rear view of the Epps lightplane showing the well streamlined fuselage and the effective tail group.

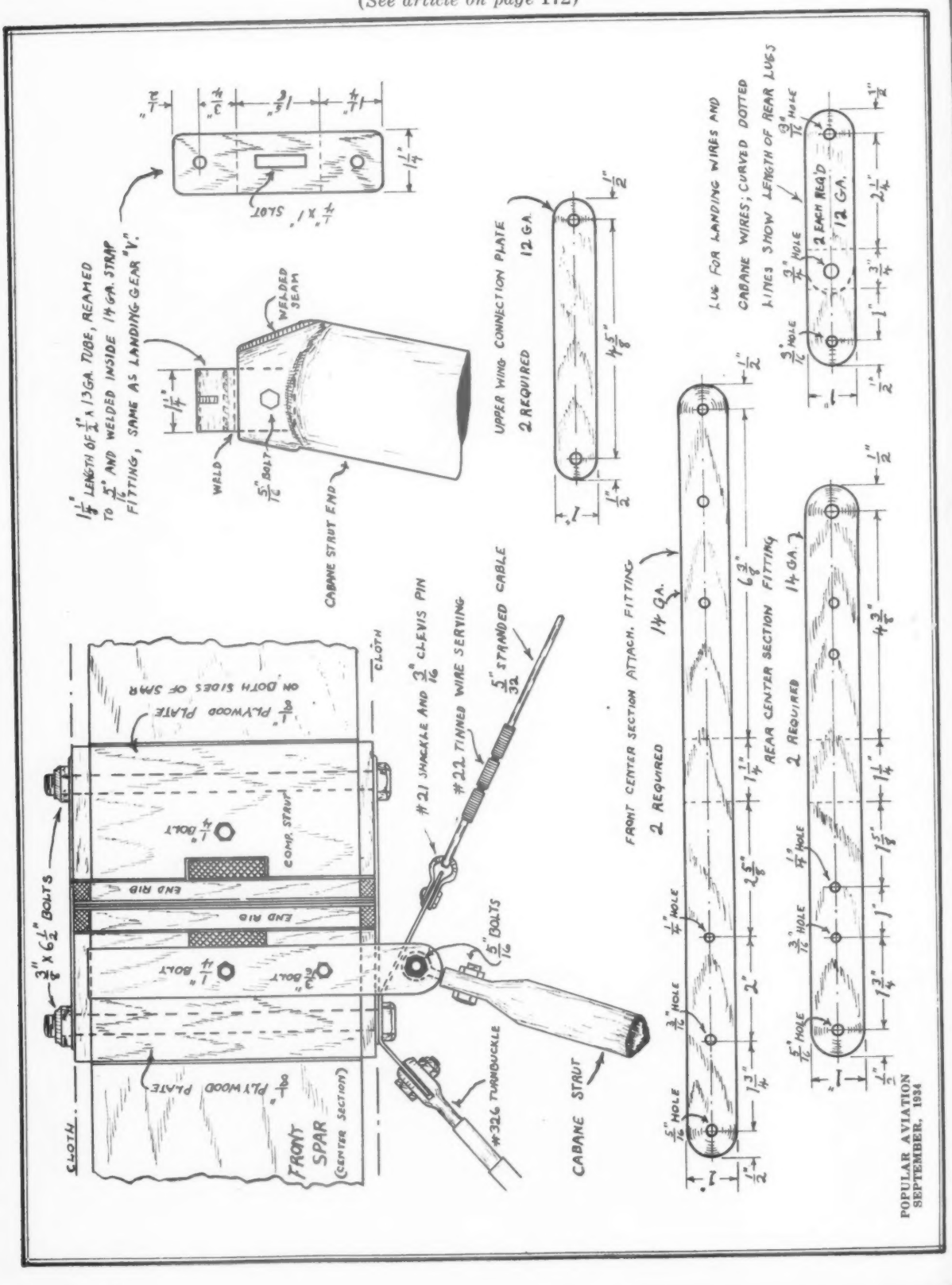


POPULAR AVIATION
September, 1934

The Epps Lightplane
Wing and Tail-Group Structures

Wing-Strut Fittings for the Epps Lightplane

(See article on page 172)



What Our Readers Are Building

A department devoted to our readers' activities in airplane, glider and engine construction, showing the latest developments.

Here Are the Details

WE take pleasure in presenting a snapshot of a Corben Junior Ace sportplane built by C. V. Lightheart and his brother, 4348 13th Ave. West, Vancouver, B. C. This fine little ship is powered with a Cirrus Mark III, 95 h.p. engine.

According to the dope received, she climbs 1,100 feet per minute, but as no airspeed meter has been installed, her horizontal speed is not known. The builders say that she can take it. Hold the stick way back and she just mushes forward, going into a glide. It has been proved repeatedly that the little ship will not fall off on one wing nor spin. This is something that some of the big builders or manufacturers better with ATC's had better look into.

It has been some time since we have heard from our Canadian friends in this department and we are mighty glad to have the opportunity of looking at an example of their handiwork. Hope we'll have some more entries from across the northern border.

T. C. Emerson, Mayfield, Ky., built the plane shown second from the top. It is powered with a Ford Model "T" engine and has a wing span of 43 feet. However, its performance is not known for the sad reason that a Department of Commerce inspector stepped into the picture, just at the time that she was to be test-hopped, and called the deal off. It's a shame, for from where we are sitting, it looks like a good job, even though the inspector has pronounced sentence on it.

John C. Miller, 216 W. Walnut St., Portland, Ind., sends in a photograph of a homebuilt plane (now owned by Gerald Rupe) that Mr. Miller and some other fellows helped him to build. It was designed by a graduate of Tri-State College, Angola, Ind., who certainly put some good looks into the job as well as excellent performance. The test-hop was made by Glen Bergere who claimed that it took off quickly and was very stable while in the air.

The engine is a 3-cylinder Lawrance developing 60 h.p. and swings a 6'-6" Retz propeller. The ship is a 2-place job, side-by-side. It has a wing span of 32 feet, 5-foot chord, a length of 19 feet and weighs about 1,100 pounds. It attains a top speed of 100 m.p.h., a cruising speed of 75 to 80 m.p.h. and lands at approximately 25 to 30 m.p.h. A 16 gallon gasoline tank is installed in the wings.

This is exceedingly good performance, for to the best of our remembrance, the 3-cylinder Lawrance does not deliver exactly 60 h.p. but something less than this. It's been a long time since we have heard of one of these engines.

Just Look What P.A.'s Readers Have Built

Mr. C. V. Lightheart and his brother, two of P.A.'s Canadian friends, have put up a fine job on this little Cirrus powered Corben Junior Ace. And they say she's spin proof—which is something.

Here's T. C. Emerson's hot little plane which has been grounded by an inspector. The view is somewhat obstructed by the barbed-wire fence but we can see enough to appreciate the excellent work.

This ship, now owned by Gerald Rupe, was designed by a graduate of Tri-State College, Ind., and she's one sweet little ship. She is sure a good advertisement for ol' Tri-State, the boys and everything else connected with the job.

P. A.'s KONTACT KLUB KOLUMN

THIS new department serves a purpose long in demand by our readers. It is a bulletin-board by which you can contact pilots, mechanics and parachute jumpers FREE OF CHARGE. We hope that you will avail yourselves of the privilege that this department extends to you and that it will grow rapidly and become an important factor in aviation.

JOHNNY EWERS, formerly of South Bend, Ind. Have some good news for you. Tried to get you at your old address but failed.—HENRY

L. MARKHAM, 362 E. Pierce St., Buffalo, N. Y. I AM looking for the concessionaire that operated the beverage stand at Lansing, Ind., airport during the meet last summer. Will give you further details in letter to follow.—JOHN SCHWARTZ, 6227 Byron St., Chicago, Ill.

TESSIE OHMER, Frank and I have worked out a new parachute stunt that is going over in a big way. Would like to have you with us on a percentage basis.—GEORGE LUCAS, 3112 W. 12th St., Uniontown, Pa.

AL KOPPERS, let your buddy know where you are.—FRED STOWLKE, 223 Superior St., Milwaukee, Wis.

CHARLEY PATTERSON (Charlie Peterson). Ed told me that you were in New Orleans about a year ago but letters failed to locate you. Let me hear from you, old-timer.—ED ROLPH, 727 W. Huron St., Chicago, Ill.

HUGO GOTHAM (Gottsheimer). Are you still in aviation? If so, I have a proposition that should interest you.—JOHN J. JEFFERY, 1926 Canal St., Chicago, Ill.

FRED STROUPE, formerly of Clinton, Ia. Would like to renew correspondence with you.—BOBBY ADAMS, 561 Michigan Ave., Eau Claire, Wis.

HARRY TUPPER, formerly of Chicago Aviation College (1926). Was thinking about that scheme of yours for covering planes. If you are still interested, let me hear from you.—ELLIS, St. Louis, 8421 Emerald Ave., Chicago, Ill.

MEMBERS of the old "Stick-and-Rudder Club," Hollywood, Calif., let me hear from you.—KARL JOYCE, 6227 Byron St., Chicago, Ill.

SALLY. Everything O. K. here, so why stay away? Nobody thought anything about that mixup—it was all a mistake. Come back like a real guy.—FLORENCE ELSTON, Skokie Airport.

K. N. R. See N. F. G. about that cracked prop. Ship grounded at present until a better log is submitted.—HENRY R. T.

JACK ATKINS, Louisville, Ky. We are going after that new D. C. order. Our ship will fill all of the specifications. Better get in touch with us.—BILL KORP, Memphis, Tenn.

LOUIS CALLAN. Why hide yourself? Use a little paper and ink and let me hear from you. —ORTON BARTH, Wolf Lake, Ind.

HERB GRANT, formerly draftsman at Western Electric Co., Chicago, Ill. Communicate with me at once.—H. L. SMYTHE, 2289 Indianolis Blvd., Robey, Ind.

JOE KELLEY, aero-mechanic. I have two ships to overhaul, and more in prospect. Come at once.—FRANK McMARTIN, Janesville, Wis.

GEORGE K. JOHNSTON please communicate with me at once. Tried to get you at the Young street address but without success. I have a really important matter to take up with you, so please get in touch with me as soon as possible —JULIAN KEMPER, 2222 Western Ave., Chicago, Ill.

M. McK. I wish to see you about something of importance, but as I have no permanent address, send your address in care of POPULAR AVIATION who will enter in next month's issue. I will write to you then.—JACK KILLIP.

DAN PETERS, formerly with Curtiss Company at Buffalo. I have some drawings for you to make just like those you made for me a year ago. Please write to me as soon as possible.

FREEMAN. Don't know your initials but if you were mechanic at the National Air Races in Cleveland, you are the man I want. We are barnstorming and intend to go to South America in the Fall. All dated up for 15 months. Write me at once.—JACK KNOWLES, 3536 Anton Ave., Detroit, Mich.

FRED WHITE, formerly of Ashtabula, Ohio. Write immediately.—ORVILLE KRAMER, Knowles, Wash.

HARRY EHLER, write to me at once. Your old job is back if you will get here in two weeks.—ELLIS THATCHER, Danville, Ill.

H. H. H., formerly of Parks Air College, East St. Louis, Ill., if you see this will you please give me Charley Kay's address—JOHN KECKLER 2214 Nakomis Ave., Milwaukee, Wis.

J. FRIED, of old Continental Aircraft Co. Look me up when you come to Chicago. Would like to renew old acquaintance.—DALY, 3124 S. Michigan Ave., Chicago, Ill.

JOE PATOK. Write to me at once. Tried to get you at the old shop but they said that you had not left your address with them.—EARL FRENCH, Corliss, Mich.

HARLEY HOSTETTER, 14 Julius Place, Cincinnati, Ohio.

HERMANN MAYO, formerly of Antler's stores, Pittsburgh, Pa., I have some new ideas on the model business. Wish you would get into communication with me right away. — FLOYD MANNER, 16 George St., Ponca City, Okla.

I WILL be pleased to hear from any of my students or flyer friends during the war.—CARL H. DUEDE, Stuart, Iowa.

ERIS DANIELS, girl parachute jumper. Please write me and let me know what you are doing. —MARJORIE L. GOODWIN, 331 Ockley Drive, Shreveport, La.

LIEUT. JOHN GEBELIN (pilot) and family. Please write to me.—MARJORIE GOODWIN, 331 Ockley Drive, Shreveport, La.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-23

Anallobar. An area of country over which the barometric pressure is rising or has risen.

Anaximander. A Greek scientist, the first to define the nature, properties, direction and intensity of the wind.

Anemocinemograph. A device for recording the velocity of the wind.

Anemograph. See ANEMOCINEMOGRAPH.

Anemometer. A revolving vane device for measuring the velocity of wind or air-currents. The Robinson anemometer consists of four hemispherical cups mounted on radial arms, the wind carrying the arms around at wind velocity. The revolutions of the wheel are counted by a recording device in the base of the instrument. The PROPELLER anemometer has a bladed fan or propeller in place of the cups.

Anemoscope. A wind vane (weather vane) indicator that shows the direction in which the wind is blowing.

Aneroid Barometer. An instrument for indicating atmospheric pressure by the movement of a flexible diaphragm mounted in the end of an evacuated box. The diaphragm movement is communicated to the indicating needle through a multiplying linkage. As indicated by its name aneroid which means "without liquid," the aneroid barometer is a portable substitute for the mercury type barometer.

Angle. The difference in direction between two straight lines, measured in degrees or radians. One angular degree is 1/360 of a complete circle or revolution. Symbol (°).

Angle "a". Abbreviation for ANGLE OF ATTACK.

Angle (acute). A "sharp angle"—less than 90 degrees.

Angle of Attack. The acute angle made by the datum line or chord of a wing-section (airfoil) with the direction of the undisturbed air steam approaching the wing-section.

Angle of Climb. Angle made with the horizontal by the path of a climbing or ascending aircraft. This angle varies with a given ship when it is climbing against or with the wind.

Angle (Critical). (1) The sharply defined angle at which any event occurs or ceases. (2) More commonly this angle refers to the angle of attack at which the lift abruptly falls off (burble point) when the angle is increased. The angle at which the air-flow changes abruptly.

GLOSSARY OF WORDS, TERMS AND PHRASES—DIC-A-24

Angle of Deviation. The angle made between the magnetic compass needle and the magnetic North. This is an angle of compass error due to the influence of local magnetic bodies that cause the needle to be drawn off of its proper indication.

Angle (Dihedral). The angle made by the two halves of a wing (split in the center) when the outer tips of the wing are raised above the center. The acute angle is then measured between one of the wings (as seen from the front view) and a horizontal line.

Angle of Downwash. The angle made by the down-trending or downwardly deflected air at the rear of an airfoil measured with the plane of symmetry. This is dependent upon the lift of the wing.

Angle of Drift. The angle made between the track and the course of a plane when a side-wind is blowing. The angular deviation from a set course.

Angle of Glide. The acute angle made with the horizontal by the downward path of a glider or airplane when the ship is being propelled by gravity alone in still air. The "best gliding angle" of a glider or plane is determined by the relation between its weight and the air-resistance.

Angle "i". Abbreviation for the ANGLE OF INCIDENCE.

Angle of Incidence. The acute angle made by the chord of a wing-section with a horizontal reference line on the plane, usually the line of thrust. This is a fixed angle built into the ship and is independent of the wind-stream. It is also called the RIGGER'S ANGLE.

Angle of Inclination. The angle made by the axis of an airplane with the horizontal. This is positive value in ascending and negative in descending.

Angle of Pitch. (1) The angle made by the axis of an airplane with the relative wind when the nose is pointed up or down. (2) The angle made by the blade of a propeller.

Angle of Roll (Angle of Bank). The acute angle made by the aircraft with the horizontal when one wing is lower than the other or when rolling from side to side.

Building the Seversky 3-L

(*See Front Cover*)

by

PAUL W. LINDBERG

Model editor and designer for

POPULAR AVIATION

Shining like a polished copper tea-kettle, this very beautiful little model of the Seversky 3-L has attracted a great deal of attention whenever it has been shown.

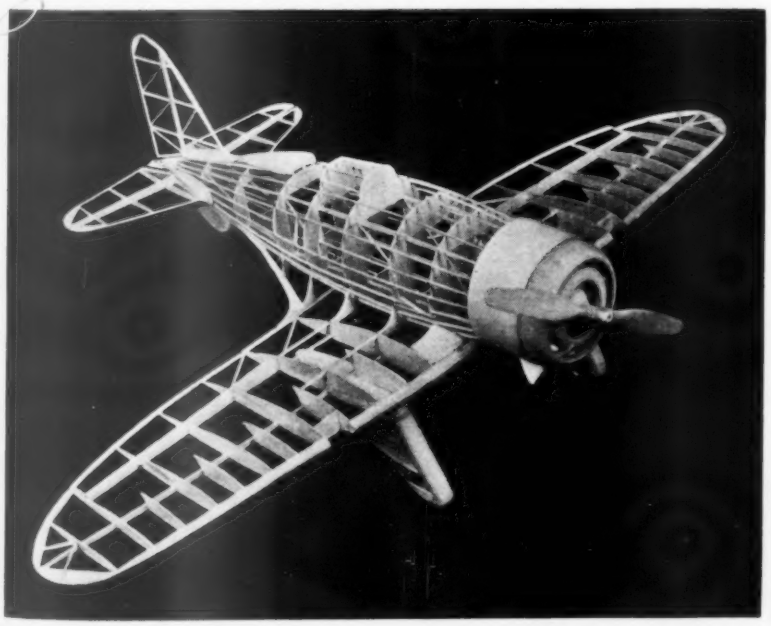
BOTH beauty and speed have been combined in this Seversky model. When painted copper and trimmed in its colorful detail it is the envy of all model builders.

Our laboratory tests of this model show: Flights of two to three hundred feet or better. Stability very good. Controls very positive. Speed between 25 and 30 miles per hour.

In building your model, follow all steps closely for many improved features are built into each successive model by this department, such as movable control surfaces with aluminum hinges, new and improved method of constructing framework, time proven shock absorbers concealed in landing gears.

All dimensions can be quickly and accurately determined by placing a ruler on the part to be measured. The plan is printed full size. If you wish a larger model, multiply this measurement by the amount of increase.

Color scheme. Entire ship copper, identification numbers black, "Seversky" on side of fuselage; letters blue with silver streaks in centers; model airplane on side of fuselage; silver, trimmed in black with silver streaks coming from rear, trimmings around cockpits, silver; exhausts and propeller, silver; other small details, black and silver.



The framework of the Seversky 3-L before covering. Note the fairing strips on the fuselage and the short sub-ribs in the wing construction.

CONSTRUCTION OF FUSELAGE

The fuselage sides are built from 1/16 inch square balsa. The longerons, verticals, diagonal braces, etc., are held in place until securely cemented, by inserting straight pins on either side of strips wherever needed, having first placed wax paper on top of plan, to prevent parts from sticking to plan. After the two sides are completed, the cross-members are cemented into their proper locations. Check carefully from front to rear for alignment.

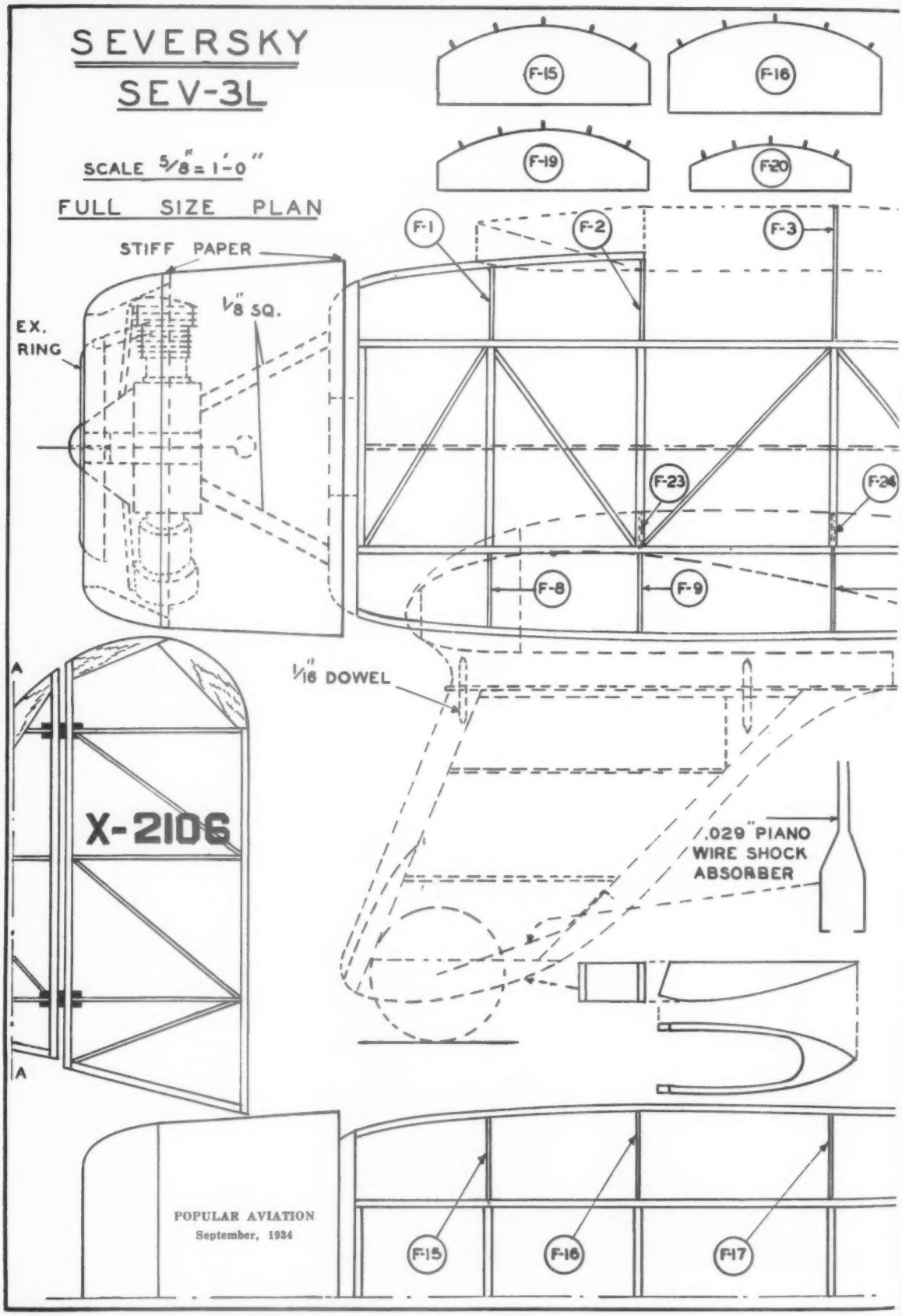
Cut the formers from 1/32 inch sheet balsa and cement in their respective positions as shown on the plan. The balsa ring which fits on front of fuselage, is cut from ¼ inch thick balsa and cemented together as shown on the plan. After this has been properly shaped and sanded cement to front end of fuselage. Next cut from solid block of balsa rear streamline tip, refer to plan, so that proper shape may be obtained, cement to rear of fuselage. The 1/32x1/16 inch stringers should now be cemented over the formers on the fuselage.

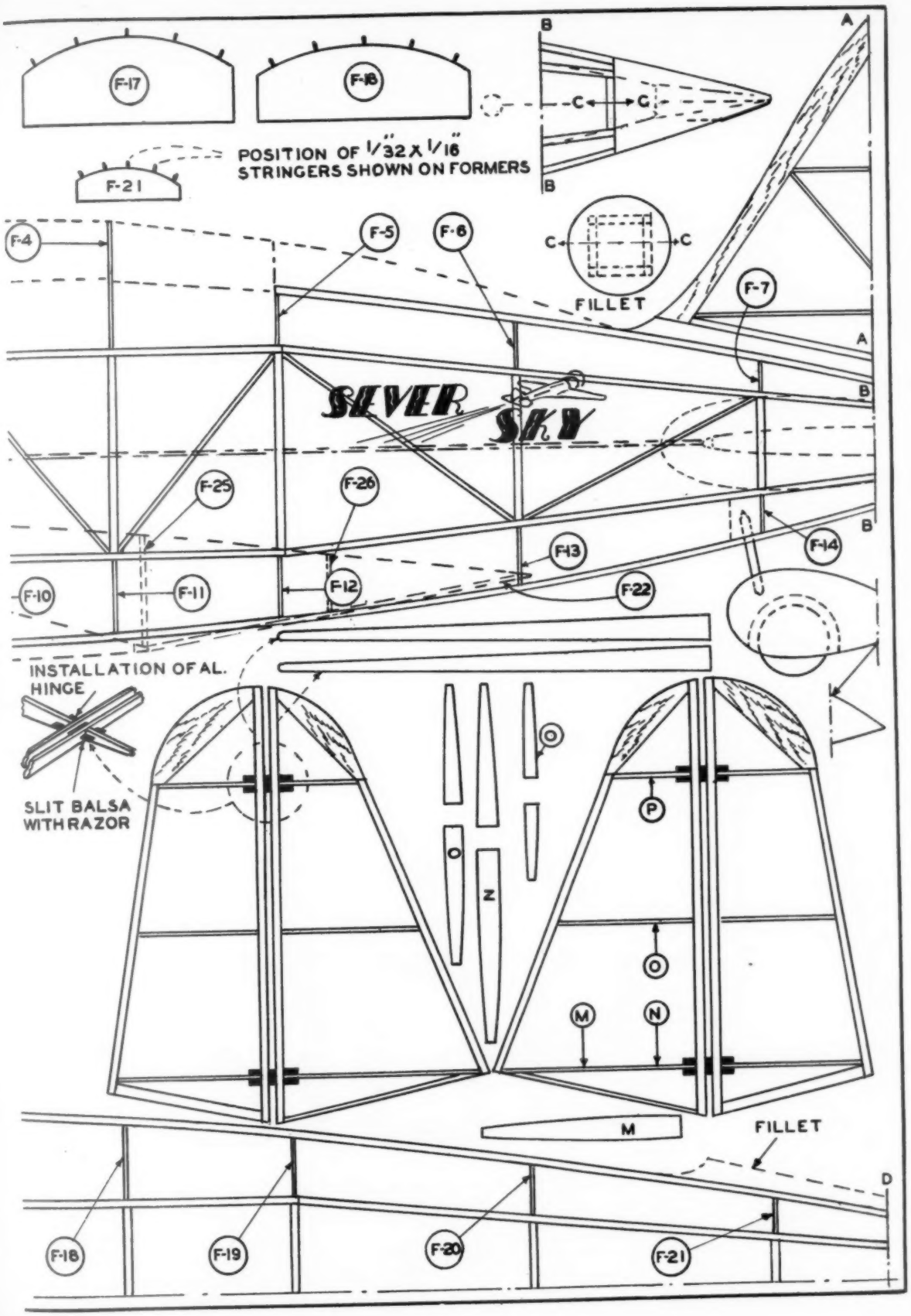
The position of stringers are shown clearly on each former. Another fine method of attaching stringers to formers are as follows: Cement top stringer working from front to rear, so that it lines up properly, next apply bottom and two side stringers. We now have four stringers on the fuselage. The other stringers should now be cemented in their respective positions, making sure that they are equally spaced. All stringers are cemented to outer edges of formers, to prevent formers from projecting through fuselage, when same is covered.

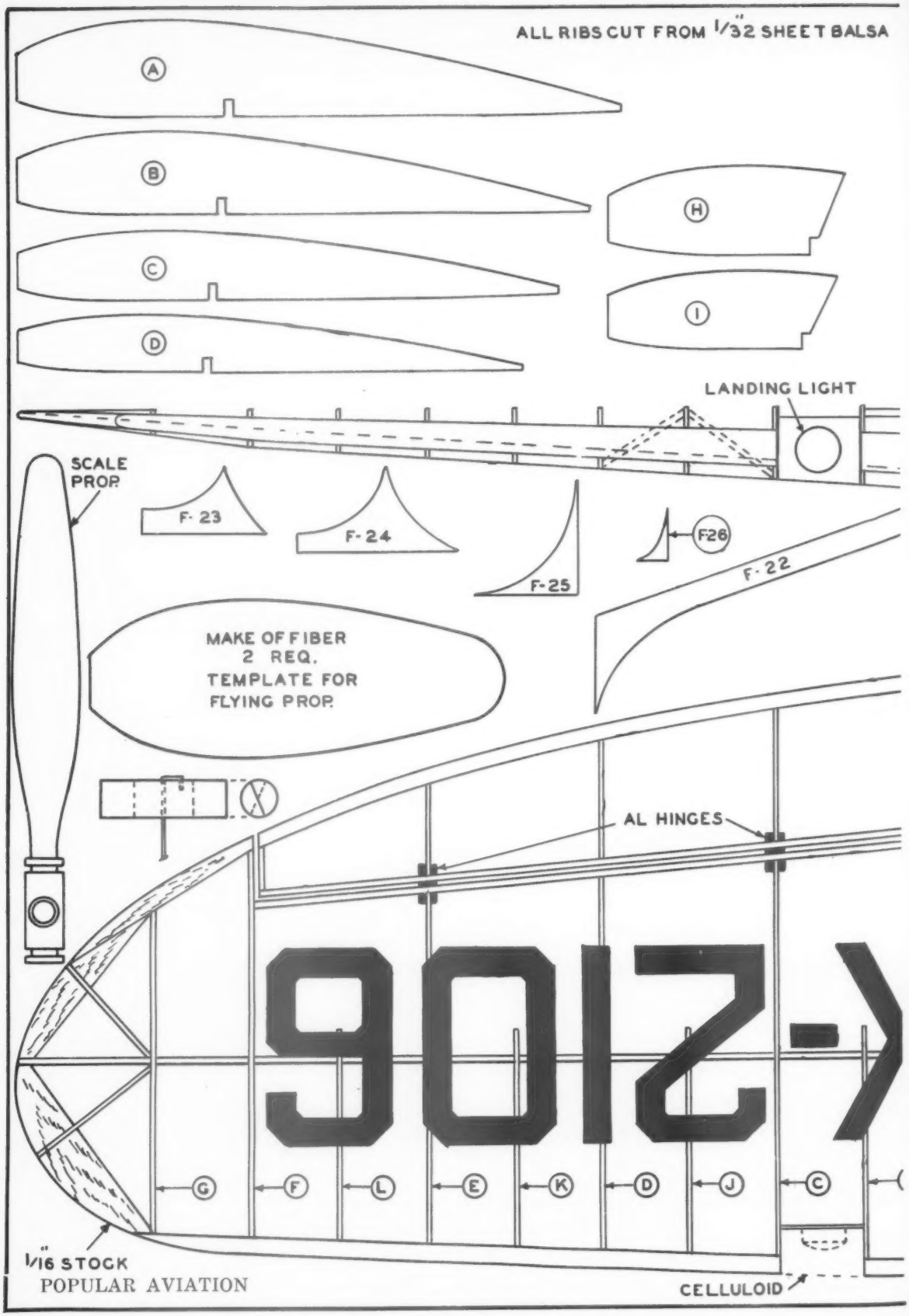
MOTOR COWLING

The front part of cowl is carved and sanded to shape from a balsa block,

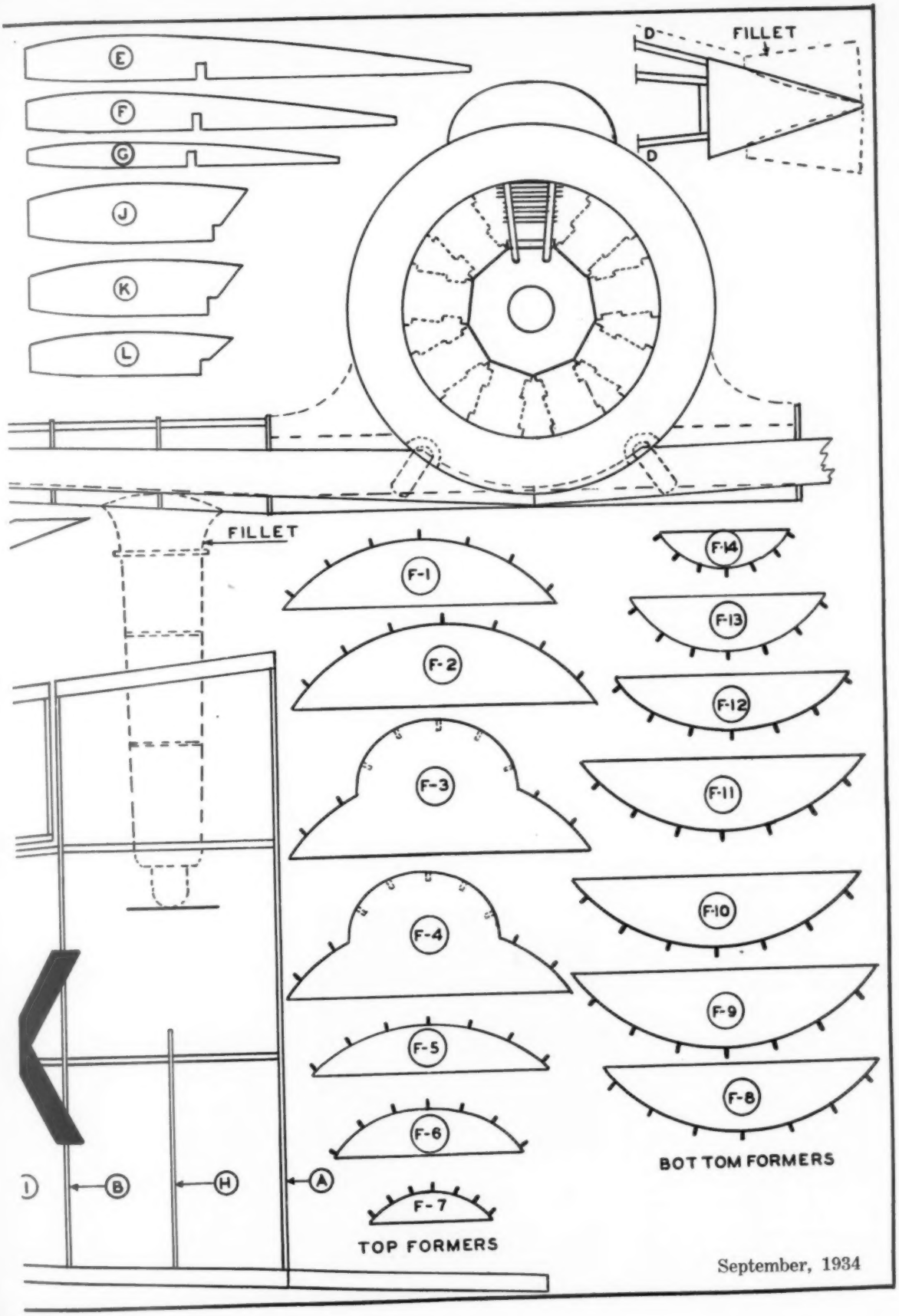
(*Concluded on page* 182)


SEVERSKY
SEV-3L
SCALE 5/8" = 1'-0"
FULL SIZE PLAN
STIFF PAPER
1/8" SQ.
EX. RING
F-1
F-2
F-3
F-15
F-16
F-19
F-20
F-23
F-24
F-8
F-9
1/16" DOWEL
.029" PIANO WIRE SHOCK ABSORBER
X-2106
A
A
F-15
F-16
F-17
POPULAR AVIATION
September, 1934


F-17
F-18
F-21
POSITION OF 1/32 X 1/16 STRINGERS SHOWN ON FORMERS
B
A
C
C
B
F-4
F-5
F-6
C
C
FILLET
F-7
A
B
SILVER SKY
F-25
F-26
F-13
F-14
B
F-10
F-11
F-12
F-22
INSTALLATION OF AL. HINGE
SLIT BALSA WITH RAZOR
O
P
O
Z
O
M
N
M
FILLET
D
F-18
F-19
F-20
F-21


ALL RIBS CUT FROM 1/32 SHEET BALSA
A
B
C
D
H
I
LANDING LIGHT
SCALE PROP
F-23
F-24
F-25
F26
F-22
MAKE OF FIBER
2 REQ.
TEMPLATE FOR
FLYING PROP
AL HINGES
G
F
L
E
K
D
J
C
1/16 STOCK
CELLULOID

9012


E
F
G
J
K
L
D
FILLET
D
FILLET
F-1
F-2
F-3
F-4
F-5
F-6
F-7
TOP FORMERS
F-14
F-13
F-12
F-11
F-10
F-9
F-8
BOT TOM FORMERS
D
B
H
A

Seversky Model

(*Continued from page 177*)

use a stiff grade of paper for cowl. Before cementing paper to balsa make sure you have the proper fit, overlapping balsa 1/16 inch.

DUMMY MOTOR

The motor is built up entirely from balsa and sheets of paper. The cylinders are built first, using the sheets of paper cut into disk, etc., to represent the fins. The layers in between these are made of sheet balsa 1/32 inch in thickness.

These are cut smaller so as to make the cylinder more realistic. The crankcase should be made from layers of ⅛ inch stock, cemented together and shaped as shown on the plan. A solid block of balsa may be shaped up equally as well. After the cylinders and crankcase have been completed, cement the nine cylinders in their proper locations on the crankcase.

The rocker-arm caps and push-rods should be shaped and cemented to the motor. Paint cylinders, crankcase and push-rods black, other small detail, black and silver.

LANDING GEAR

Select a fairly strong grade of balsa and shape all landing gear parts as shown on plan. After framework of streamline wheel coverings has been built, music wire is formed into shock absorbing axles as shown on plan and cemented to framework with wheels. Sides of wheel coverings may be covered with either tissue or balsa veneer.

CONSTRUCTION OF WING

Cut all ribs from 1/32 inch sheet balsa. Pin center spar in position on the plan, next cement ribs in their proper locations. The leading and trailing edges are now cut and sanded to shape and cemented to front and rear of ribs.

Make wing tips as shown on plan from 1/16 inch sheet balsa. We recommend this type of wing tip, as it is far simpler to construct and neater in appearance.

The ailerons are now built into the panels. Ailerons will eliminate the need for building "wash-in" into wing. We recommend that you build your model with all movable controls, as you will need these to control your model under flight. Aluminum hinges are cemented into position after wings, etc., have been covered with tissue.

APPLYING WING TO FUSELAGE

Leading edge is cut to the proper curve, so that it will fit snugly against bottom stringers. Center spar from Rib A to Rib A is cemented in at a horizontal position. Trailing edge also cemented in a horizontal position.

Apply cement to leading and trailing edges and center spar and fasten to bottom side of fuselage. All formers which work from ribs A to fuselage stringers are cemented into position, after first being cut and sanded to shape.

Seversky and the SEV-3-L

(*See Front Cover*)

THE Seversky Model Sev-3L, employed as a special racer, will be equipped with a Cyclone 715 h.p. engine and will have a top speed of 260 m.p.h. This model is a landplane of the same general type as the seaplane shown in POPULAR AVIATION some months ago.

The cruising speed is said to be 240 m.p.h., and carrying 600 gallons of gasoline, will have a range of 3,000 miles. With full load, the initial climb will be 800 feet per minute. Thus, if certain business developments at the Seversky plant do not interfere with Major Seversky's entry, the Sev-3L will prove a formidable contestant for the MacRobertson Race.

Major Alexander P. de Seversky is as interesting as his plane. He was born at Tiflis, Russia, in 1894 and became an American citizen in 1927. He graduated as a Lieutenant from the Imperial Naval Academy of Russia, and later took a post graduate course in aeronautical and mechanical engineering.

During the World War, his plane was shot down, the observer was killed and Seversky lost his right leg. He was then temporarily made inspector in charge of aircraft production, but in 1916, he was permitted to return to the front, and in spite of his artificial leg, assumed command of a bombardment squadron in the Baltic Sea.

A Super Model Maker

A. F. BRISTOW, Reading, England, makes wind-tunnel models for the Royal Air Force. It goes without saying that this requires the greatest of accuracy for the models must be exactly to scale and perfectly constructed down to the last thousandth of an inch.

His job is making wind-tunnel models.

Contest Winner Delighted With Trip

Floyd Kowalak, P.A. Contest winner holding the Boeing "247" trophy.

A FEW days ago, Floyd Kowalak breezed into our office on the way back home from an epoch making trip. Floyd, as you probably know, distinguished himself by taking first prize in P.A.'s model contest and took the trip to the West Coast as his reward. Let us reproduce his letter.

"Several days ago I returned home from the most wonderful trip I ever had. The service aboard the United Air Lines planes and at the airports is great. Travel by plane is the fastest and most comfortable of all.

"I have traveled 6,000 miles, spent two and a half days in Seattle, one day in San Francisco, two days in Chicago and back home in one hour less than a week. It is hard to believe that so much can be accomplished in so short a time.

"I have realized a lot from your contest. A wonderful trip and vacation. Getting a job at the Consolidated Aircraft Corp., as a direct result of the contest. And lastly, selling my model for $200. It was well worth the investment of $30 for materials and three months' work."

A Long Model Flight

A MODEL airplane with a wing spread of 6 feet, 1 inch, carrying a fuel-load of 13 ounces of gasoline, recently flew from Camden, N. J., to Middletown, Del., a distance of 54 miles.

The plane was built by Maxwell Bassett of Philadelphia. It was in the air 2 hours, 35 minutes. After its fuel supply became exhausted it glided for ten miles in descending circles and made a safe landing in a pasture.

What the Industry is Doing

Latest bulletins from the airplane, engine, equipment manufacturers and dealers boiled down into a nutshell. Contributions to this department are invited.

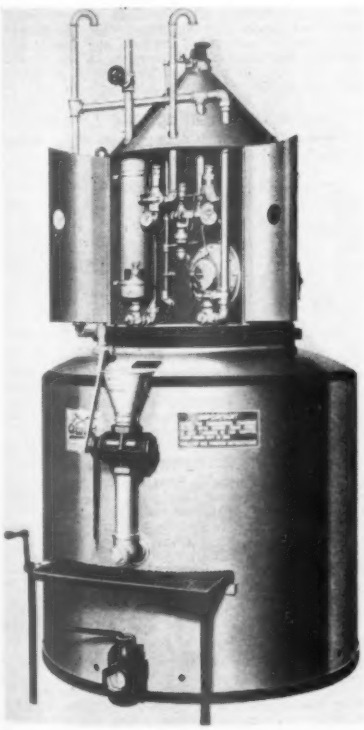
NORTHWEST AIRLINES, within 30 days of the receipt of the first Lockheed "Electra" took up its option on two additional Electras and then placed an order for two more, making a total of five. The first Electra is making two round trips daily between Chicago and St. Paul, carrying capacity loads.

THE MONOCOUPE CORPORATION, St. Louis, Mo., was sold by the estate of the late Phil DeC. Ball to a group of St. Louis men. Of the latter, Harry Hall Knight was one of Lindbergh's original backers.

SALES of the Stinson Aircraft Corporation, division of the Cord Corporation, for the first six months of the company's current fiscal year, were nearly 300 percent. greater than during the similar period last year. Sales for the period totaled approximately $500,000. Practically the entire amount of business was due to the new Stinson Reliant.

AT LEAST seven of the 58 contestants in the London-to-Melbourne International Air Races are expected to fly American-built Lockheed monoplanes. Three American and four foreign pilots are preparing Lockheeds for the McRobertson race. The most famous of these pilots are Wiley Post with the Winnie May and the Australian pilot, Sir Charles Kingsford-Smith. Sir Charles will defend his title having established the record over this course in 1930.

WALTER BEECH, Wichita, Kansas, founder of the old Trabel Air Company, reports that many orders are now coming in for his new Beechcraft. This plane, which has a surpassing performance for its type, has become very popular within a short time.



The new automatic acetylene gas generater known as the OXWELD Type MP-4.

NORTH AMERICAN AVIATION, INC., has reduced the number of its directors from 21 to 7, the present board consisting of four members identified with General Motors interests while three members represent minority interests. General Motors Corp., with its affiliate, General Aviation Corp., controls 51 percent. of the stock of North American Aviation, Inc. The present set-up is due to the conditions laid down by the government for carrying airmail.

Three of the old companies owned by North American Aviation, Inc., have been changed. Eastern Air Transport, Inc., has become Eastern Air Lines. Transcontinental and Western Air, Inc., has been changed to TWA, Inc., while General Air Lines is the new name for Western Air Express, Inc. Each of the new companies was a successful bidder for the new temporary airmail contracts.

ELLIOTT ROOSEVELT has been elected vice-president of the Aeronautical Chamber of Commerce of America, Inc. He will devote his whole time and attention to the problems that relate to every phase of the industry.

SPORTSMAN AIRPLANE AND SUPPLY CO., Hobart, Okla., is well known in the Southwest. The original company was organized in St. Louis, Mo., 1929, by J. B. Cooper who, with L. J. Specht, developed the first Sportsman Monoplane. Since the firm moved to Hobart, Okla., the business has been carried on with the added assistance of R. L. Cooper and others who are interested in the promotion of sport flying.

The results of past activities have now been combined into several sportplane designs that will be developed for this year's market. Each model, using approximately 90 percent. of the basic structural design, will sell at exceptionally low prices. Building to a basic design also greatly simplifies the matter of replacements and repairs. The first two models of the new series of sportplanes will be completed at an early date while the other models, including a series of closed planes, will appear in the Fall.

KARL ORT, York, Pa., has just issued an interesting and valuable catalogue of aviation supplies which he will mail to all interested on the receipt of 10 cents. This catalogue is exceedingly well illustrated and complete.

BY ERROR, the "Aero-Bike" control attachment, built by The Church Airplane and Mfg. Co., Chicago, Ill., was referred to by the name of White. This device, which is most ingenious, can be applied to any bicycle and gives excellent training in the use of lateral control.

SUBSTANTIAL growth of the air-express is indicated by the fact that 135,000 pounds of air-express was handled at the Chicago Municipal Airport the first five months of this year while only 150,000 pounds was handled during the entire year of 1933. This increase is said to be due to lower rates, faster schedules and more frequent schedules.

A NORTHROP DELTA of the A/B Aerotransport in Europe, set a new record between Stockholm and Paris. It flew the 1,000 miles in 4 hours and 40 minutes, or at the rate of 214 m.p.h. This cuts in half, the time required by European built transports to fly this route.

THE FIRST PICTURES to arrive from the Second Byrd Antarctic Expedition, show part of the enormous supply of 19,450 gallons of gasoline being hauled from the flagship Jacob Ruppert, over the snow to little America. This transfer is being made for the beginning of the exploration flights and tractor journeys which are to start in October which is the "spring" in Antarctica.

THE FIRST of the ten new type Boeing 247-D air liners, equipped with geared Wasp engines, are soon to be delivered to the United Airlines. The use of the new geared engines shows a marked improvement and the all-round performance.

Capt. Charles R. Bowers, Chief Instructor of the newly organized Bendix Employees Aviation School, South Bend, Ind. Capt. Bowers has had extended experience in aviation over a long period of years.

AIR TRANSPORT OPERATIONS in the United States were studied by three engineers of the Research Institute of Aviation Engineering, Aero Fleet of the United States of Russia. The members of the inspection group were A. Vissman, P. Davidov and D. Moscov.

A RECORD is established by United Air Lines, a record for planes in simultaneous flight. At no time during the 24 hours are there less than 15 planes in the air at one time, flying over the airways. This unusual activity is due to the inauguration of hourly service on the United Air Lines between New York, Cleveland and Chicago, and additional coast-to-coast flights.

CONTINENTAL OIL COMPANY, Ponca City, Okla., has placed an order for a Lockheed Electra. It will be used for fast executive transportation throughout the United States, Canada and Mexico. Another Electra, the first ordered by an oil company, was purchased by the Phillips Petroleum Company, Bartlesville, Okla.

IT IS RUMORED that Anthony H. G. Fokker, famous Dutch airplane designer, will enter the McRobertson race with a new Lockheed Electra.

THE C. F. PEASE COMPANY, 813-821 North Franklin St., Chicago, Ill., have introduced a new popular priced continuous blue-printing, washing and drying machine. This is known as the Model 11 Peerless Blue-printing, washing and drying equipment. It is designed for paper 42 inches wide which it feeds at the rate of 12 feet per minute. It is equipped with three new Pease Super-Actinic enclosed arc lamps taking 17 amperes each and a ¼ h.p. motor which provide a printing range of from 4 inches to 12 feet per minute on either A.C. or D.C. current.

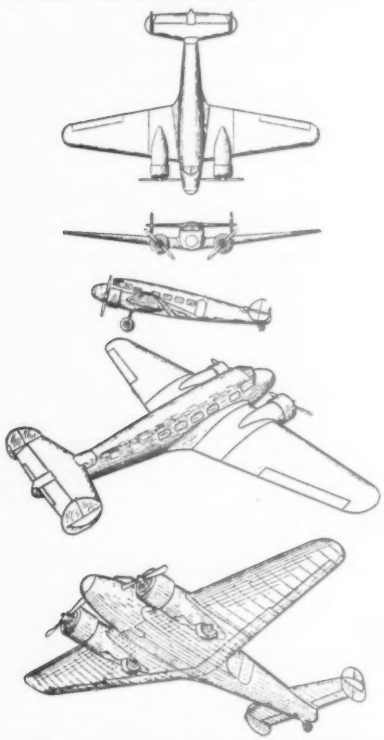
A NEW automatic stationary acetylene gas generator, known as the Oxweld Type MP-4, has recently been announced by The Linde Air Products Company, 30 East 42nd St., New York, N. Y. It is rated to deliver 1,000 cubic feet of acetylene per hour, the highest capacity medium pressure model now available. The new generator is of the gravity feed type set to deliver about 13 pounds per square inch pressure, but adjustments are provided by which the pressure can be varied within a range of about 2 pounds.

Recent Patents in Aviation

A page of interesting aviation patents issued by the United States Patent Office. This information is supplied monthly by Rummler, Rummler and Woodworth, Patent Lawyers and Engineers, 7 S. Dearborn St., Chicago, Ill.

AIRPLANE DESIGN, No. 92,654

Hall L. Hibbard, Burbank, Calif., assignor to Lockheed Aircraft Corporation. Issued July 3, 1934. Term of patent 14 years.



This is a design patent covering the ornamental design of a bi-motor transport plane, evidently the design of the Lockheed "Electra."

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PARACHUTE HARNESS, No. 1,964,864

Stanley Switlik, Trenton, N. J. Issued July 3, 1934. 10 claims.

In this parachute harness the main supporting webs extend from under the seat of the wearer, up the front, over the shoulders, under the arms with the terminal ends extending toward the front. There is a separable connection between the terminal ends and the front of the harness.

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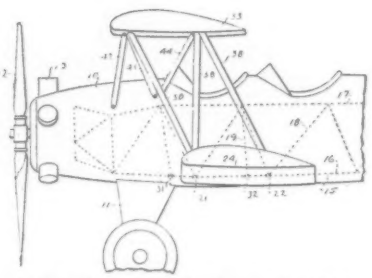
AIRCRAFT, No. 1,965,185

Joseph M. Gwinn, Jr., assignor to Consolidated Aircraft Corporation, Buffalo, N. Y. Issued July 3, 1934. 6 claims.



A device for varying the stagger of a biplane, the lower wing being provided with special connections that fit into a number of sockets spaced along the lower longitudinal of the fuselage.

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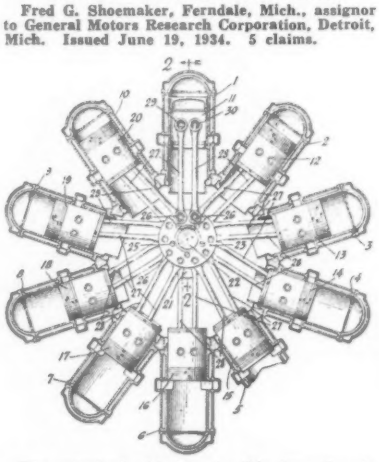
CONN. ROD DESIGN, No. 1,963,423

Fred G. Shoemaker, Ferndale, Mich., assignor to General Motors Research Corporation, Detroit, Mich. Issued June 19, 1934. 5 claims.



The principal objective in this invention is to connect the connecting rods with the crankpin in such a way that the motion of all the pistons will be exactly similar which is not the case with present arrangements. Two rods are used with each cylinder which gives a parallel or pantagraph motion without a master-rod.

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CONN. ROD ASSEMBLY, No. 1,962,246

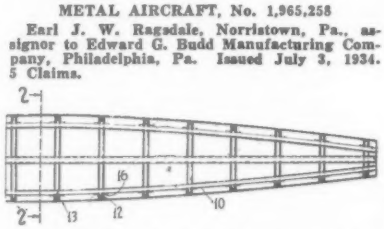
Arthur H. Leak, Hamburg, N. Y., assignor to Wright Aeronautical Corporation. Issued June 12, 1934. 2 claims.

This patent covers the master-rod of a radial engine in which the blade end of the rod engages with the crankpin. Blade bosses are formed at this point for the connection of the forked secondary rods.

• • •

METAL AIRCRAFT, No. 1,965,258

Earl J. W. Ragsdale, Norristown, Pa., assignor to Edward G. Budd Manufacturing Company, Philadelphia, Pa. Issued July 3, 1934. 5 Claims.



A fuselage construction of metal consisting of longitudinals connected to channel section rings through flexible gusset plates. The sheet metal skin is attached to the rings.

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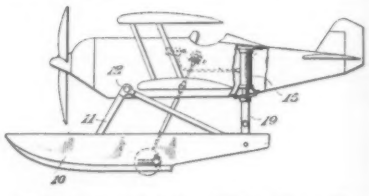
LANDING-GEAR, No. 1,963,630

Alexander Procofieff-Seversky, New York, N. Y., assignor by mesne assignments, to Seversky Aircraft Corporation. Issued June 19, 1934. 22 claims.



This is an amphibian landing-gear with a skid pivoted to the body. The position of the skid is controlled by a hydraulic cylinder for different landing conditions.

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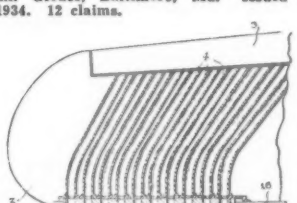
LATERAL CONTROL, No. 1,962,390

John Gerdes, Baltimore, Md. Issued June 12, 1934. 12 claims.



Lateral control especially adapted for tailless airplanes or planes with short tails as a replacement for wing-tip rudders. This comprises an element with a passage near the wing-tips, extending from the leading edge to trailing edge, and a means of controlling the airflow through the passage. Variations in the flow of air through the passages varies the resistance and lateral attitude.

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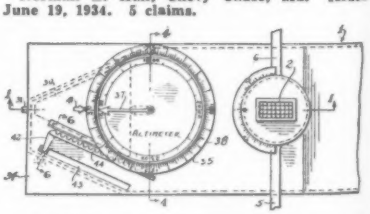
AERO-INSTRUMENT, No. 1,963,899

Norman B. Hall, Chevy Chase, Md. Issued June 19, 1934. 5 claims.



An instrument for determining ground speed of an airplane in connection with an altimeter that automatically compensates for the altitude. The pointer of the altimeter moves along the scale for correcting the ground speed.

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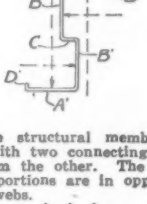
AIRPLANE ELEMENT, No. 1,963,416

Robert J. Minshall, Seattle, Wash., assignor to Boeing Airplane Company, Seattle, Wash. Issued June 19, 1934. 10 claims.



An airplane structural member formed of sheet metal with two connecting webs slightly offset one from the other. The oppositely directed flange portions are in opposite direction to the offset webs.

• • •

Lithuanica

(*Continued from page* 144)

over, and the plane finally came to a stop with a terrific crash, tearing out the motor and crumpling the fuselage as if it were paper.

If the ship had run out of gas, Darius would have stalled it in as easily as possible. Such a thing had happened to him in the United States at one time and he brought the plane down into the tree tops with little injury to it and none to himself.

On the other hand, if the flyers had been severely wounded and were attempting to get out of the country while still conscious, it is conceivable that the ship might have been flown into the tree tops. Struggling against a growing weakness caused by loss of blood, perhaps with one flyer dead, the ship could easily have been flown into the trees as vision and strength failed. *The cockpit of the plane and parts thrown far from it, were soaked with blood. How does this hook up with the rumor of the blood-soaked handkerchief in the mail bag?*

The manner in which Germany reacted to the tragedy was incongruous, to say the least. Germany had never been friendly with Lithuania and since the advent of the Nazi regime the tension has grown steadily greater, with Germany growing more insolent in her attitude toward the smaller country.

With the crash of the "Lithuanica," however, the Nazis performed an about face that left the countries of Europe gasping. The flyers were honored as no one but Hitler has been in the past few years. The people of Soldin declared in flowery phrases that a monument would be erected on the site of the crash. This, however, has never been done and has been forgotten.

The Nazis gathered flowers from all over the countryside, flying some in by plane when the local supply gave out. Guards of honor, flowery press notices, pretentious processions marked the route of the flyers' bodies to Lithuania. First to Berlin, then Stettin and then by plane to Kaunas. It was too perfect. It was too good an example of a bad boy afraid of being caught at a dirty deed, suddenly being the model of righteousness in an effort to divert suspicion and conceal the true facts.

From the time the bodies left Soldin until they reached Kaunas, they were in caskets soldered shut and guarded. A funeral ceremony of great pomp was conducted in Kaunas. Then the bodies were taken by the Lithuanian government to be embalmed in such a manner as to last a thousand years. This was done with the permission of the flyers' families.

Near relatives of Darius tried to see the bodies. For three months they were put off with weak excuses. Each day an attempt was made to see the bodies. Each day it failed. No one but the few working on the bodies were permitted near them, and they would not talk.

Finally, with the help of a friendly high official, they were permitted a brief and secret glimpse of the dead flyers. For three months surgeons had been at work, replacing parts, remolding features, doctoring the bodies. *On the legs of Darius, however, were seen some round holes, such as bullets would make.*

Now, a year later, comes a report that one of the workers where the bodies were treated came to America and, in addressing a small group, stated that he had seen bullet holes in the bodies. A French newspaper came out boldly and said that bullets had been extracted from Girenas' body. Another authentic report stated that three bullets had been found in the chest of one of the flyers. *Here are three reports, all dovetailing!*

In Germany itself, in the Social-Democrat newspaper "Neuer Vorwarts," headlines announced that the flyers had been shot down by Storm Troopers near Soldin. The paper went on to say that when the plane flew low over the concentration camps, that the guards thought them to be "enemy" flyers and shot at them with machine guns. The first news out of Soldin was of the same nature.

The first Nazi official news called the tragedy an accident. Does this excuse stand up under another statement in "Neuer Vorwarts" to the effect that doctors and all those at Soldin were instructed to conceal all clues of the crime? In the Lithuanian Daily News, Chicago, a letter was printed which was received from a high official in Lithuania. His name is, of course, kept secret. He writes as follows:

"I have read most of the continental and Lithuanian-American press accounts of the disaster and the grounds for suspecting foul play. Frankly, to my mind, such grounds do exist. In Germany's present mood, and more particularly where those degenerate lunatics, the Nazis, are concerned, such an outrage against an alien aeroplane would be merely a trifling incident.

"I can moreover well understand why, even if evidence of foul play was discovered at an autopsy on the bodies here in Kaunas, the Lithuanian government would not care to stir up trouble at the present time. For economic and political reasons, Lithuania cannot afford to heighten friction with her powerful neighbor. Then, too, both Darius and Girenas were American citizens, and so actually the Lithuanian government had no authority to raise such an issue.

"Both French and Polish papers have very definitely declared that diplomatic circles in Berlin entertained no doubts whatever on the subject, and were satisfied that the flyers had been shot down by the guards of the concentration camp in Pomerania. Naturally, nothing can now be proved, but unquestionably this hypothesis does seem to

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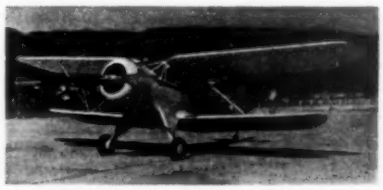

Above is a photograph of the new WACO Cabin, Model "C", which represents four years of development and offers unmatched performance. It requires no coddling, no extensive maintenance, no expert handling—and is honestly and sturdily built to meet the trying conditions of private ownership. Below, is a view of the interior, showing front seats and instrument board.

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fit the facts in quite a startling manner."

POPULAR AVIATION disagrees with the latter part of the letter which states that, "nothing can now be proved." If they were shot down, it can be proved. Every opportunity has been given to prove that the "Lithuanica" was *not* shot down, *and it has not been proved!*

POPULAR AVIATION is not interested in international politics. It *is* interested in *justice*, in fair play, in sportsmanship. The unknown Lithuanian official spoke only too truly when he said that it was America's place and not Lithuania's, to settle the matter satisfactorily. It has not been settled! There are too many damning facts in the way! The evidence is too strong not to warrant investigation!

Why has the matter not been thoroughly investigated by the American government? These two men were American citizens, entitled to every consideration as such. It is up to our State Department to find out the *truth*. It is nothing more than *just* to demand that it be ascertained if they were murdered. International intrigue binds other nations and the matter is really beyond their jurisdiction. Fear of reprisals in dictator-ridden Europe seals the mouths of those intimately connected with the affair. We repeat: It is up to the United States!

END

Sidelights

(*Continued from page* 166)

some experiments made a year or so ago.

If the kite were flown at a height of five hundred feet or more and the air drag on the car or boat (due to the sails) adequate, the velocity gradient or difference in wind speed between the two levels might be sufficient to sustain the whole affair in the air. If Ki-kung happened to fly a string of very large kites, which encountered winds in opposite directions at different levels, he might even have been lifted vertically. I have observed both of these effects on a small scale during my experiments and have also had a single kite soar vertically above me in a rising current and carry away a stone of considerable weight attached to the kite string.

Knowing the skill of the Chinese in building and flying kites, I would be inclined to accept almost any story recorded in their history during a period of 3,000 years or so of kite flying. Unfortunately, Chinese historians generally devoted very little space to kite flying, usually regarding it as a waste of time and unworthy of attention.

There are a number of references in Chinese history to "wooden kites," built prior to the invention of paper, sufficiently large to carry a man and used for various purposes, including military observation. Kunk-shu Tse, a contemporary of Confucius, is recorded as building such a kite capable of remaining aloft with a man for three days.

Since Chinese kites were copied after birds, the name of the kite itself being derived from the bird of the same name, it is not improbable that such a wooden kite might have possessed the power of soaring flight, attained first by maneuvering in a high wind at the end of the line and then, on occasion, being released for free flight. Certainly, the fact that the bird after which the kite was patterned was capable of free flight on practically motionless wings would have inspired efforts along this line and we know in the light of our experience how easily it may be accomplished.

The idea of using birds to support a flying car also seems to have been a Chinese inspiration. Although in their illustrations the bird was usually "souped up" as a dragon in line with their symbolic treatment. This scheme permeates the pre-history of aviation in almost all countries, the thought, no doubt, being derived from the common practice of using animals of various kinds to draw carts and chariots.

Whether, as stated in the stories of the past, success was achieved is comparatively unimportant. What is most important is the question of whether, in the light of present day knowledge, such a thing could be accomplished. At least one man, Captain C. W. R. Knight of England, has succeeded recently in training a very large eagle and controlling its flight, as I had excellent opportunity to observe when he gave a demonstration with his pet on the stage of the Field Museum here in Chicago. Captain Knight obtained this bird, I understand, from a Siberian tribal chieftain whose ancestors have trained and used eagles in place of falcons since time immemorial. It would not take very many eagles of the kind owned by Captain Knight to lift a considerable weight and I really believe they could be made to work in harness, bound to the structure of a sail-plane.

The Peruvian condor, growing to fourteen foot wing span, almost approximates airplane size and performance and must form an interesting comparison with sailplanes now experimenting in the Andes. The writer has amused himself from time to time by working out the details of a sailplane with eagle or condor auxiliary surface and propulsion as well as a method of training the birds to work in harness on a sailplane running along an aerial wire.

The idea of an "aerial horse" is not so ridiculous as it might seem at first glance. The surprising thing is that the scheme apparently has never been tried out in modern times and has remained merely a dream of fiction writers.

We pass lightly over the very simple scheme for aerial navigation supposedly practiced by the Taoist priests of China and possibly derived from India, where Buddhists of the Tantra school had the same idea. This might be described as the true lighter than air method, the Taoist simply refraining from eating until he grew so light (or light headed) that he floated off into space without wings or other means of support.

Since the depression hit us, some pilots in this "land of plenty" have been forced to try the Taoist system but have not reported success as yet The Taoist believed that in order to conquer the air one must live on air. Some present day employers are suspected of conversion to Taoism.

The distinguished Taoist priest T'ao Hung-king about 500 A.D. claimed to have discovered something which reads like a modern gasoline or oil advertisement. He called his concoction the "flying elixir" (Fei tan) and gave the formula as a mixture of gold, cinnabar, azurite and sulphur—one gulp and you leave the ground. I don't doubt it!

Present day large-scale training of youth in Europe for aviation by glider practice reminds me that in both early Chinese and British legends the idea crops up that evolution of a flying race of men could best be accomplished by fitting the children with wings and teaching them to hop and then fly down gentle slopes.

In England this developed during the reign of Bladud, who was known as the Flying King of Britain. He was the tenth king and the father of King Lear. Bladud was killed by a fall in the year 500 B.C. when his feather wings failed him.

The folklore of India specifically describes two types of airship, the Garuda of native manufacture, and the Yavana of Greek construction, the design of the latter being a jealously guarded secret. Since, at the period in question, the Alexanderian epoch, Greek mechanicians are believed to have accomplished wonders in other lines of ingenuity and artistry, it seems not unlikely that artificial flight received serious attention and that some success was achieved as the records indicate.

We must remember that flying machines are necessarily rather fragile and bulky constructions not apt to come down to us through the ages unscathed as have the marvelous sculptures and other more substantial examples of the skill and mental development of early China and Greece. Then again, the attitude of Emperors and Kings toward flying machines seemed to be that these contrivances should be reserved for their special use or else destroyed. The priests regarded the things generally as creations of the devil and in fact if a well-preserved specimen of prehistoric airship managed to survive the religious bigotry of the dark ages I would be inclined to believe in miracles.

END

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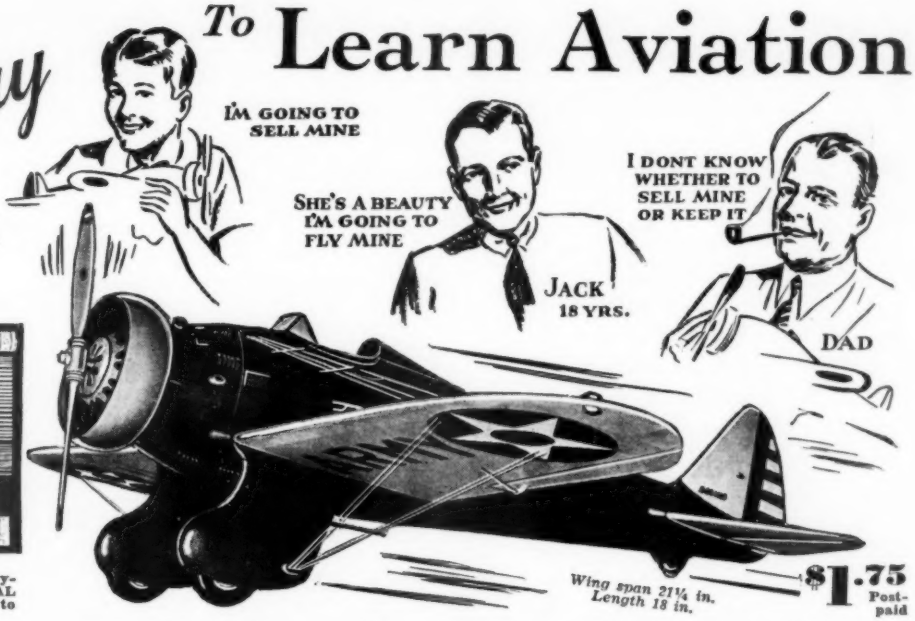

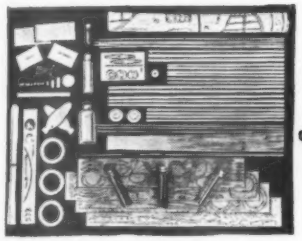

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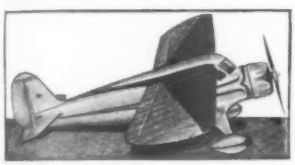

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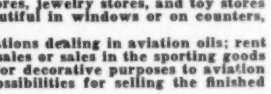

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5½"	40c	6¼"	70c	4½"	25c	5 "	45c
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Airships

(*Continued from page* 148)

the first rigid airship of metal. At that time aluminum was not only a scarce and expensive metal but a material very difficult to work. Nevertheless, the ingenious Schwarz built an airship 156 feet long of the light metal, and he powered it with a gasoline engine. A German soldier went up in it, but the gas leaked out and the heavy metallic affair plunged for the ground. Just before it struck the earth, however, the pilot jumped and saved his life.

In the same year, that colorful Brazilian of French descent, Santos Dumont, became interested in building balloons. He left the coffee plantation of his father in sunny Brazil and went to Paris—a free wealthy generous young man, looking for adventure. He found it in the new sport of ballooning.

Santos Dumont was the ideal promoter in the development of a new device, young and energetic with all the money he needed to spend in experiments and no financial worries. He married himself to the dirigible balloon and linked his name forever with its development.

He built many airships, propelling them by gasoline engines, and had a great many adventures in them. One, No. 5, cracked up on a roof near the Eiffel Tower, but No. 6 circled the Eiffel Tower and made a flight of seven miles in less than 30 minutes, winning its owner and operator a prize of 100,000 francs.

At length, Santos concluded that he had solved all the problems of lighter-than-air flying and turned his impetuous attention to the more dangerous heavier-than-air experimentation.

Thus, we come at last to a man who, in the popular mind, is given practically the whole credit for the invention of the airship—von Zeppelin. The author certainly would not detract from the deserved glory of this patient worker and leader in airship construction, but he would point out the correct origin of that glory.

Zeppelin belongs in the third movement of man's creation and evolution of heavier-than-air craft. We have seen how the broad pioneer thinkers saw the need for the craft and made fantastic solutions in conversation and on paper, and how the practical, building inventors devoted their lives and money to the testing and evolution of those ideas.

Zeppelin had administrative and engineering genius; he and his associates took the dirigible and made it a practical servant of mankind. A man of great determination and perseverance, thoroughgoing and patient, Zeppelin organized a company with a subscribed capital of 1,000,000 marks ($238,000) and proceeded to test details, build and operate airships. This association of men of which he was the leader did a very good engineering job, but their actual inventions were confined to details of construction.

Like all other machines it was not by one man nor one group of men, but by the human race.

Where the present airship will go from here is a source of dispute among aeronautical students. But the author is of the opinion that the faith of the hundreds of thousands of men who have given their lives for its creation and development will not have been in vain.

In common with many other observers, he believes that the all-metal airship will find its best sphere in extremely high flying, a messenger between continents and an explorer of outer space.

As a space-ship, it will become an infant again. The author believes that after a few more stratosphere flights are made some bold experimenter, with money to back his efforts, will build a streamlined, duraluminum balloon, carrying hydrogen (or a vacuum) in its top end, powered with a rocket engine in the lower, pointed end of the streamlined body, and having a sealed space for passengers between the buoyant compartment above and the rocket engine below.

In some such craft our builder will float upward from the earth a way, then turn on his rocket engine and catapult into space; ten, twenty, thirty, forty or fifty miles he will go, until the explosive fuel gives out. Then he will settle back by the force of gravity to the earth's air envelope, where the gas bags will float him like a free balloon. Throwing off ballast, he will descend in safety.

When this happens, the beginning of the era of practical development of space-flying will have begun. Man will conquer space little by little; but surely he will conquer it, as he has conquered and is conquering the air.

END

Epps Lightplane

(*Continued from page* 172)

tened and fastened to the rib by means of a metal strap in the usual manner.

Fasten the ribs to the spars with casein glue and small wire nails, driven into the spar through the capstrips. The leading edge is likewise attached with glue and nails.

Filler strips, ½x¼ in. in cross-section, must be placed on top and bottom of the rear spar between the ribs at the aileron opening. Do the same thing on the aileron spar. This is to keep the cloth from sagging between the ribs.

Notice, too, that hardwood filler blocks, ¼x1 in., are glued and tacked to the spars at the wing mounting bolt holes.

The installation of the internal wire bracing and the ⅜ in. sq. wood braces is the final step in the wing assembly.

END

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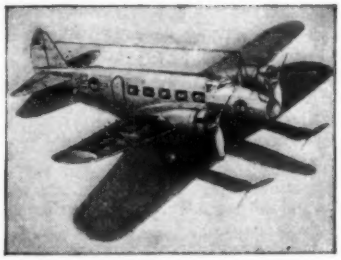

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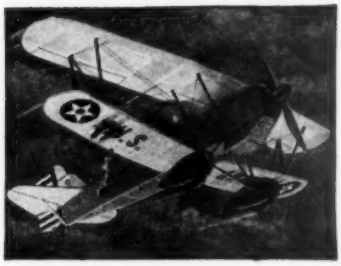

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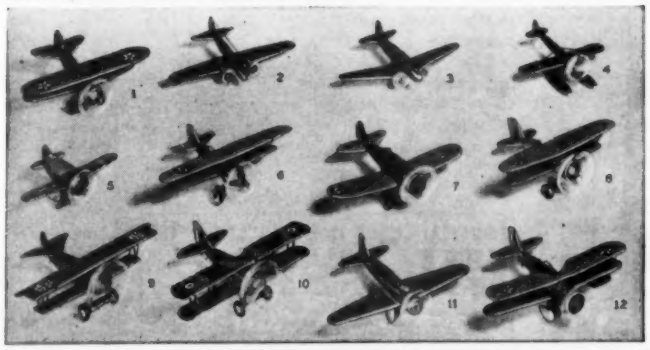

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Aviation Gas

(*Continued from page* 164)

sulting in a sacrifice of some other qualities of motor fuel.

This condition is tentatively admitted by none other than the high authority of the federal specifications board. As soon as this board sets up a special anti-knock grade for aviation gasoline, it eases up a bit on volatility as is seen by glimpsing the distillation range on the latter product and comparing it with that of fighting aviation. In fact, these specifications retreat a considerable way back down the line toward domestic aviation gasoline, in distillation temperature requirements.

Octane number in gasoline is a measure of the resistance of that motor fuel to the tendency to knock in an internal combustion engine. Octane numbers are coming to be familiarly treated by the general public, but the government is still holding off from including them in requirements for any government gasoline except the special anti-knock fighting aviation gasoline, specifications for which have not yet been given here. Generally speaking, the lowest grade gasoline sold for automobile use is U. S. motor gasoline of 59 octane number, or less. Some of the third-grade gasoline which falls in this classification might even drop to 50 or perhaps 40. It would never do in an aircraft engine.

Going on up the line, what is known as "regular gasoline" now carries an octane number of anywhere from 60 to 70. Most of the major companies claim to be selling a product rated at 70 as their regular gasoline. Most of them are obtaining this result by the use of a limited amount of tetra ethyl lead, known as "ethyl fluid," blended with the gasoline at the refinery or the bulk plant.

The premium gasoline now being sold at automobile service stations carries a 78 octane rating. If it is a product which carries a larger shot of ethyl fluid, it is sold as true Ethyl gasoline.

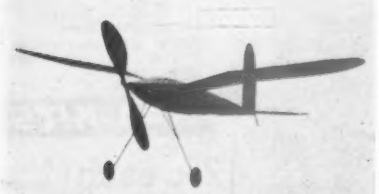
The injection of what is known as "natural gasoline" into the situation of recent years has made gasoline much peppier. Natural gasoline is the product obtained by condensing the gaseous vapors coming to the surface in connection with the production of crude petroleum, and consequently it is not a refinery product, strictly speaking. Natural gasoline is highly volatile — the "unstabilized" grades being so much so that it evaporates amazingly rapidly.

From this brief resume of the motor fuel situation, it will become apparent that the subject is one of much interest and importance to aviation. In general, in aircraft operation, the quality of motor fuel is satisfactory and few complaints are really justified. This is due to increased technical progress in the petroleum industry and to co-operation between the two industries.

The specifications of anti-knock fighting grade gasoline are interesting, but they are too long to be included with this article. They will be contained in an article to follow.

END

SENSATIONAL



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IMPERIAL MODEL AERO SUPPLY

416 McDONALD AVE. BROOKLYN, N. Y.

On the Outside

(*Continued from page* 156)

tinue on up into the air in the manner of all well behaved airplanes.

The airplane, however, evidently had quite different ideas, and with a few warning sputters the motor quit cold, leaving me surprised but too busy coaxing the gillopie just above the roadway over into a little pillbox of a field on the other side to feel any real emotion at the situation. The gentleman in the speeding car was literally astonished, however, much more astonished than I was, I'll wager, for the only warning he had was the sight of an airplane wing calmly skimming along about two feet in front of his windshield.

I didn't see him stop but I heard him. His brakes certainly needed oil on them or something—or do you oil brakes? Well then, maybe it was the something. Anyhow, I was just wiping off a collection of moisture which had collected on my face for some unaccountable reason and was mentally congratulating myself enthusiastically that both the airplane and myself were still in one piece, when up puffed the aforementioned irate gentleman, who was very irate indeed.

He glared at me for one long, meaningful minute, then sighed long and deeply. "Aw hell," he growled, "it's a woman!" And thereupon stalked off, leaving me, for practically the first time in my life, positively speechless. Which adequately sums up the attitude of the entire male flying public. No matter what the situation involving a woman pilot, if a man is stumped for anything better to say, he invariably falls back on the cry: "Aw hell, it's a woman!" and lets it go at that.

I suppose this article is going to let me in for an explosive bombardment of criticisms and defenses for the Great American Male Pilot. I want to state here and now that I realize I am not perfect and have many, many faults and many, many disagreeable traits. I too am in the wrong in a lot of ways, and probably deserved a lot of what I've experienced—but not altogether, brother, not altogether. Now just calm yourself, and look at the thing with unprejudiced eyes, or rather as nearly unprejudiced eyes as you can make 'em, and maybe you'll agree with me some, huh?

If the great American male doesn't believe my ravings, just let him put on a woman's regalia, adapt a high falsetto voice and go out to the airport. Then, I'll bet that he will see things from my standpoint, always providing, of course that he is not kissed to death before then.

And now, for a charming and appropriate little climax, I have the measles! At least the doctor says it is the measles. If you ask me, I've just broken out with a rash trying to figure just what in hades the men pilots do expect from women who fly? You tell me!

END.

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250 Miles

(*Continued from page* 150)

I was all tricked out like Santa Claus, of course, and the store had spread the glad tidings that Santa Claus was arriving straight from the North Pole by airplane and was landing on its roof. We circled at a 2000-foot altitude, and it didn't look so good to me. I signalled the pilot to go down a bit, but still it looked uninviting. I could see the peaked roofs hemming in the building, and also the top of the store simply bristling with white spots, like a bed of daffodils.

We kept circling, getting lower and lower. I knew the pilot couldn't collect his fee unless I jumped and I knew there were several thousand kids down there waiting to see Santa Claus drop out of the sky. So at 700 feet, I jumped—and it was a fool thing to do.

I was right above a gas tank when I pulled the rip-cord, and I thought the 'chute never would open. Before it did balloon out, I was 50 feet from the building, and all I could see was clusters of white spots. I found out later they were spikes, left sticking up as reinforcement for concrete pillars when additional floors were to be added to the building.

I missed them all, but I really don't know how I did it, and landed within two feet of the cross. But that was close enough—almost too close. For they hadn't simply painted a cross on the flat surface, as I expected, but had built it up—to make sure I'd see it—out of a two by four frame work, and if I'd hit it, as I was trying to do, probably the least I could have done was to break both legs, dislocate my hips and fracture a few ribs.

I had another narrow escape in Florida, in the boom days. But that one was due entirely to my desire to be playful and show off. I was pulling a stunt, hoping to get a job promoting real estate sale. I thought if I could attract enough attention to myself, some real estate promoter would pay me to jump at random, so to speak, and offer a free downpayment on a lot to the first person who got to me. So I jumped on my own one day over Royal Palm Park in Miami—off-hand.

I'd say I was aiming at a space one by two blocks. I remember a single border of palm trees on one side and a double border with a walk between on the other. I came down over the double border. A big crowd saw me coming down and cleared away. But between the double row of palm trees I saw a man and a girl on a bench—paying me no attention.

It was a good chance for a little aerial gagging. So I pulled the cords and slipped the chute, heading straight for them. They saw me when I was less than 25 feet above them and skipped away. But it was too late for me to make what you might call a really graceful landing. I think there must have been a little ground current between those two rows of trees. At any rate, I was suddenly swirled around, and came down in a spiral, spraining both ankles. But I got the job, promoting real estate.

The second time I hit a roof—deliberately—was at a G. A. R. convention at Newcastle, Pennsylvania, in 1930. Unknown to me, there was a movie camera man on the roof I was aiming at, but fortunately for both of us, a ground puff at the last minute made me change my plan and settle on another flat roof—nearby. If I'd stuck to the original target, I'm afraid neither I nor the camera man would have enjoyed it—or survived to tell about it.

The two times I landed on roofs, when I didn't want to, were at Johnstown, Pennsylvania, and Jackson, Michigan. At Johnstown I was advertising the opening of the baseball season and trying to land in the park. But the wind was bad and my information about the topography of the district inadequate. I saw below me steel mills, railroad yards, a river, and innumerable unpleasant prospects.

I kept slipping my 'chute, tugging the cords on one side as adroitly as I could—to guide myself—until presently I discovered the drift had me directly over the main part of the city and I was losing altitude rapidly.

I was so low I could distinctly see a traffic policeman at an intersection and I tried to attract his attention, to signal him to clear the intersection so I could land here. But he either failed to see me or didn't get the idea. So I kept coming down, down, down. I saw a vacant lot, about 200 by 100 feet and aimed for that but missed it by a few feet and came plunk down on a steep slate roof.

If my 'chute hadn't billowed down on the opposite side of the roof and held me, I would have slid on down—and I'd rather not think of what that would

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have done to me. At Jackson the situation was much the same—only I was aiming at the fair grounds, which is just across the road from a prison.

When the wind began to get funny with me, I started to get funny too—I thought it would be a good stunt to land in the prison yard. I could even see the headlines—"easy to get in but hard to get out," or something like that. But I fetched myself down on another peaked roof and had to hang on for dear life until rescued.

People often ask me if I wasn't afraid when I made my first jump. I don't recall being afraid at all. I don't think I was even what you might call nervous—although I've seen plenty of jumpers who are pretty shaky before each jump, even after they've been at it some time.

Most people who have never made a parachute jump are terrified at the thought of making one. As a rule, they aren't so much afraid of the landing. They simply dread the thought of leaping out into space. They are afraid they will forget to pull the rip cord, or pull it too soon.

In either case, such a thing happens so seldom it is hardly worth considering. Contrary to the general impression, it isn't customary to count up to any specified number, before pulling the rip cord. That belief is largely a myth. You just jump with the idea in mind to pull the rip cord promptly and by the time that idea is put into action, you're in the clear.

I think the time is coming when passengers in transport planes will all be equipped with parachutes. Experiments are being conducted now to perfect a quick, safe method for automatically discharging passengers from a crippled plane—through the use of a collapsible seat over a trap door, or something of that kind.

As for the sensation of falling from a moving plane, there is nothing really exciting or disturbing about it. When you leave a plane that is flying at a speed seldom less than a mile a minute, you do not feel that you are falling. Forward motion is just altered into falling motion, and you are scarcely aware of the directional change. It is not at all like a fast elevator.

The feeling when you jump from a relatively stationary position in space—from one parachute before opening the second, or from a balloon—is somewhat different, of course. But there is really nothing frightful even about that. It's just about the same as starting down suddenly in an express elevator—certainly no more nerve racking than a sudden drop on a roller coaster. At the most, you just feel as if you had a stomach full of animated chestnut burrs.

END

Sikorsky

(*Continued from page* 146)

is useful load. Top speed at sea level is 134.7 miles, and cruising speed is 115 miles per hour.

The plane has a range of 500 miles with 40 passengers, or 950 miles with 24 passengers. To anyone familiar with aerial transportation between North and South America, the S-40 is a common sight.

In the summer of 1932, Mr. Sikorsky completed a design of a large seaplane in accordance with specifications outlined by Colonel Lindbergh, who acted in the capacity of Technical Advisor for the Pan American Airways. This plane, The S-42, has just been completed and is now being flight tested. This ship is to be the forerunner of a regular trans-oceanic air mail and passenger service.

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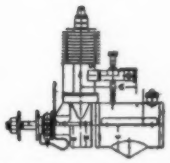
1/5 H.P. Gasoline Motor. Flies 5 to 10 ft. Models



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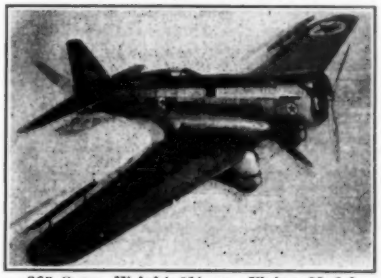

36" Span, Weight 3½ oz., Flying Model
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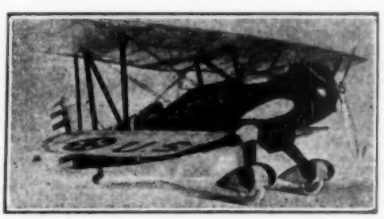
Curtiss Sea Hawk P3A

24" Span, Weight 1¾ oz., Flies 900 Feet
Set includes 3" celluloid motor, aluminum motor plate and drag ring, balloon celluloid wheels with silver discs, printed instrument board, fuselage, wing and rudder insignia, aluminum pilot's seat, dope, glue, drawing and all materials. Const. Set Complete $2.50
Same Set with 3¾" Scale celluloid Hornet Motor without cowl. Postpaid 2.95

Boeing F4B4 Pursuit

22½" Span, Weight 2¼ oz., Flies 750 Feet
Set contains 3" celluloid motor, aluminum drag ring and motor plate, ribs and formers printed on balsa, celluloid wheels, silver discs, wing, rudder, Army and fuselage insignia, semi-finished prop., Yellow and silver dope, glue, drawing and all materials. Const. Set. P. P. $2.95

Curtiss Army Hawk P6E



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Aero-Sportswomen

(*Continued from page* 156)

son, Mrs. Kathryn Pederson and Ardette Cadwallader.

Mrs. Pederson was one of the first women to learn to fly in Denmark and helped organize and run the first Danish airline, and Ardette Cadwallader, who was formerly of Chicago, is now an active member of the 99's in California.

The dinner, which was served on the veranda overlooking the lagoon and the fairyland of lights, was limited to women pilots. But the Quiet Birdmen, WNAAs, the Sky-Ride Aero Club (an organization of employees of the famous Sky-Ride who are pilots) Department of Commerce inspectors and doctors, the pilots of the Sikorskys and the Goodyear blimps at the Fair and many other air-minded fans were invited to come in to hear the lecture.

Major Fordney resplendent in his Marine Corps uniform (summer white, with glittering gold braid, buttons and anchors) began his lecture by telling of the scientific research and achievements of the Army, Navy and Marine Corps. "So many people think of these merely as destructive agents," he said, "but the scientific research and developments in health, sanitation and establishing law and order in outlying possessions have been far more important achievements."

Major Fordney described the stratosphere flight in picturesque Marine Corp and Navy terms and paid high tribute to the character, achievements and courage of Lieutenant-Commander Settle.

The story of the flight was illustrated with an interesting set of lantern slides showing the preparations, inflation, ascent and other views taken from the gondola of the ship. In one picture, taken at the maximum altitude, the net-work of fields, roads and a small village were clearly visible. The powerful lens of the camera had been able to record much more than was visible to the men from the ship. Another slide that was of especial interest was a chart record of the flight, showing the distance traveled in miles, hours and altitudes.

In addition to the many scientific records they had been asked to make, Major Fordney said they had had several requests to settle the much discussed color of the sky.

"We took up color charts and to be sure that we would give an unbiased opinion—since Commander Settle might have a leaning toward Navy blue and I might be accused of favoring the Marine blue—we made independent observations and then compared them when we got down. And I am glad to report," he continued with a merry twinkle in his eyes, "that we both recorded that the stratosphere blue is a *true* Marine blue!"

Sally Rand, who will go down in history with the Century of Progress of 1933, has returned again this summer and is appearing in a review in the Italian Village. The following story sent in by Helen Waterhouse of Akron, Ohio, is an interesting sidelight on this rather amazing young woman.

* * *

SALLY RAND, the girl who made fan dancing famous, has been a licensed airplane pilot for years and is a great aviation enthusiast.

After a recent plane trip to Akron from Chicago, the scene of her World's Fair triumph, she discussed, not the problems of the stage and her art, but rather the advantages and technicalities of flying, with Helen Waterhouse, flying reporter.

"I always travel by plane," she said watching the porter as he carefully lifted the cylindrical box in which she carries her two precious seven-pound fans from the plane. "It is the quickest, cleanest and most comfortable mode of travel. No cinders, no dust, no heat. That means a lot to me after working hard the day and night before. I can lean back and relax and sleep until I reach my destination. Also I find it no more expensive."

Two air experiences which might have daunted a less plucky person than the little blonde fan dancer, have not taken away her zest for air-travel at all.

Once last year, she hired a plane to take her from St. Louis to Omaha. "It was bitter cold but I thought, of course, the plane was heated," she said. "When we were flying somewhere over Nebraska, the oil line broke, and oil blew back on us covering us from head to foot. We made a forced landing and then I discovered as we waited and waited for help to come, that the plane was unheated and that my foot was frostbitten.

"But that was nothing to the time we were grounded for 12 hours in a transport plane on the Utah desert in the midst of a big blizzard and with the thermometer at 12 below zero. It happened there were six women and two men in the plane, and we women had to keep the men cheered up until help came by joking and laughing as if we were not uncomfortable at all."

Miss Rand has the honor of having made the longest "theatrical" hop 'cross country on record. That was when she left Denver at 9 P.M. one night and arrived in New York at 8 A.M. the next morning.

Her flying career started in 1927 when she won her pilot's license in Los Angeles. She estimates that she has about 240 hours to her credit, which includes a flying tour she made of the west, and to Vancouver, thence eastward to Milwaukee, Chicago, Cleveland and New York.

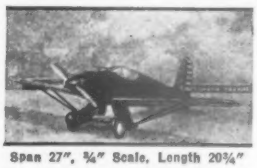
This throws an entirely new light upon the achievements and talents of the renowned Sally, who hitherto, has been regarded only as a dancer by "her public." And just to set all doubts aside in the matter we have checked up her time with the D. of C. and will proclaim to the world that she has underestimated her air-hours.

"I don't get nearly as much time to fly myself as I'd like to," she confesses.

Sweet, dignified and quietly dressed, Miss Rand might be any girl pilot talking about her flying career. She has the calm unruffled personality which makes good flying material, her instructors say.

END.

CURTISS SWIFT



Span 27", ¾" Scale, Length 20¾"

This trim, low wing, high speed fighting plane has just been developed for the United States Army by the Curtiss Co. It is so new that actual data on its performance is not yet public. With its clean streamlining and its even, smooth metal covering it readily lends itself to the mad, tearing speeds typical of the present day fighting planes of the world.

The Peerless Kit is complete, containing PRINTED WOOD for all wing ribs, bulkheads, etc., clearly printed on smooth cut sheet balsa. Strips of the correct degree of strength form the job. Colored Peerless yellow for the wing, Olive Drab for the fuselage, Silver for the propeller and cockpit inside, and Black for touch up. Special wheels and a turned and slotted spinner are included. All insignia printed in the correct colors. The plans are enormous, two clear pictures are shown and everything is full size.

Flights of as far as 600 feet have been made with the test model. You'll be thrilled and will thrill 'em when you bring this one out. Complete kit only **$2.50**

DEALERS: Write for details of our Dealer Plan.

Send 5c stamp for illustrated folder of Kits and Supplies.

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DEGREE IN 2 YEARS

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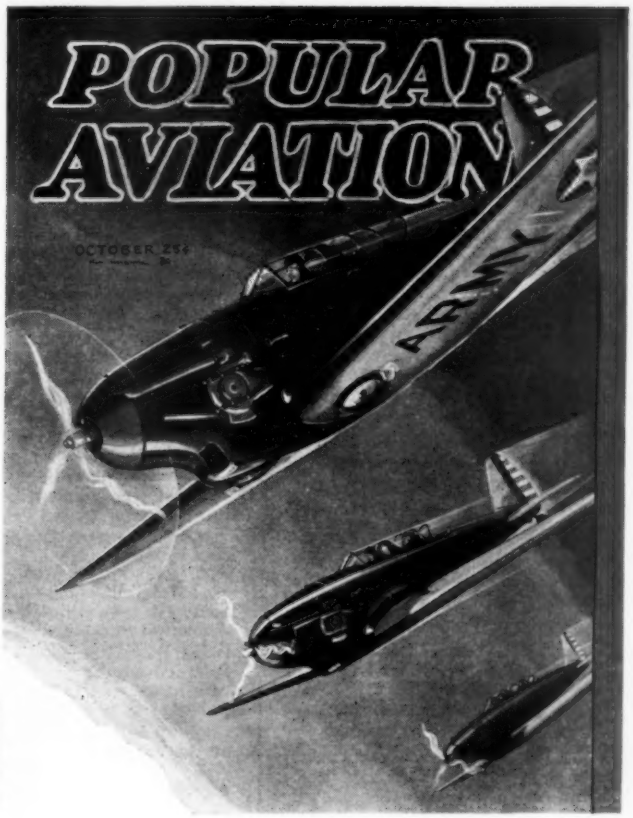
TRI-STATE COLLEGE



HERE COME THE P-30s

In this issue, there's a complete description of the new Consolidated P-30 jobs that are a decided novelty in military planes. They will be shown in full colors on the cover.

The OCTOBER Issue

IN THE October issue of P. A. will be a highly interesting account of a new ship, now under construction, that has made major changes in its propulsion. *Steve O'Connor Says* is another new feature starting next month, written by one of *aviation's most picturesque characters* in a style all his own. Other special articles will discuss rockets, radio and Bert Hall, the Yank who ventured into China. A great issue, don't miss it.

ON ALL NEWS STANDS SEPTEMBER TENTH —BUT MAKE SURE OF YOUR COPY

POPULAR AVIATION,
608 S. Dearborn St., Chicago, Ill.

Gentlemen:

Enclosed please find one dollar for a five month subscription to POPULAR AVIATION. This subscription is to start with the next issue (October).

NAME.....

STREET (RFD).....

CITY.....*STATE*.....

Engine Quiz

(*Continued from page 160*)

Q. What is a magneto?

A. A small magneto-electric generator driven by gearing to the engine. It develops the high-tension current directly as long as the engine is running, converting mechanical energy into electric energy for the spark.

Q. How is the battery ignition system used?

A. This consists of a storage battery (usually twelve-volt), a spark coil and the necessary timer. The spark coil builds up the battery voltage from twelve volts to more than fifteen thousand volts so that the current can jump between the plug electrodes.

Q. Which is the best system?

A. *Both systems have their merits. The magneto system has no storage battery to run down and cause trouble, but on the other hand, the modern airplane requires battery current for the lights and the radio so that under such conditions it is usually advisable to use a battery system.*

Q. Couldn't both battery and magneto be used?

A. *They often are, such systems being known as "dual" or "duplex" ignition systems.*

Q. Is more than one magneto used?

A. *Usually, when three or more cylinders are used.*

MULTI-CYLINDER ENGINES

Q. Why is more than one cylinder used on aviation engines?

A. *To obtain smoother running, less vibration and a more uniform propeller torque. This also does away with the necessity for a heavy flywheel.*

Q. Why are multi-cylinder engines smoother running?

A. *Because the power is divided up among a number of cylinders, hence the firing impulse of each cylinder is much reduced. Again, the impulses are closer together, and the impulses in many cases actually "overlap" so that at least one cylinder is working at all times.*

Q. Why are the firing impulses closer together?

A. *A single-cylinder four-stroke engine fires only once every second revolution. A two-cylinder engine fires once every revolution; a four-cylinder fires twice every revolution while an eight-cylinder engine fires four times every revolution. In the latter case, the application of power is almost continuous.*

Q. What about the comparative size of the cylinders?

A. *For a given total amount of power, the cylinders of an eight-cylinder engine are very much smaller than for a single-cylinder engine, the weight of the reciprocating parts is much less and the impulses are less intense.*

Q. What about propeller efficiency?

A. *With a multi-cylinder engine and a more even distribution of speed during the revolution, the turning effort on the propeller is smoother and the propeller is therefore more efficient.*

Q. Are multi-cylinder engines more efficient?

A. *No, they consume more fuel per horsepower than a single-cylinder engine because there is proportionately more heat radiating wall surface with a small cylinder than with a large one.*

Q. What is an "in-line" engine?

A. *An engine with all of the cylinders in one line on one side of the crankshaft.*

Q. What is a "vee" type engine?

A. *An engine with two rows of cylinders, the two rows making an angle of 45 degrees, 60 degrees or 90 degrees with one another, depending upon the number of cylinders and other conditions.*

Q. What is a radial engine?

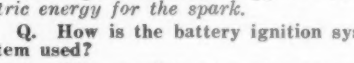
A. *An engine with the cylinders arranged around the crankcase in radial lines—like the spokes in a wheel.*

Q. Name some peculiarities of the radial engine.

A. *A single-row radial engine, with one row of cylinders, has only one crank and it always has an uneven number of cylinders such as 3, 5, 7, 9, 11.*

END

WORLD WAR RELICS



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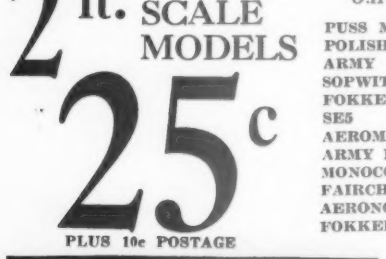
FOKKER D8



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A CHARGE of three cents per word will be made for all advertisements entered in the Barter and Exchange columns. Please enclose remittance on this basis when submitting copy.

AIRPLANES

WANTED—OX Travelair or Bird, cracked or otherwise. Licenseable. Will trade CineKodak and two complete Lionel Trains, wide gauge, and cash.—G. Lytle, Missouri Hotel, St. Louis, Mo.

HEATH PARASOL 1931 with instruments, less motor, also Austin business coupe 1931 model, both in excellent condition. What am I offered?—Harold Zander, 310 Fir St., Michigan City, Ind.

HEATH HENDERSON PARASOL, not a licenseable model, but a good flyer. Needs a propeller and wings. Should be recovered. What have you?—Gail Hildreth, 209 Bond St., Clarksburg, W. Va.

TRADE for light car, special Church Szekely 30, A-1 flying condition, built by licensed mechanics. Experimental license X787W. Never cracked. Also ATC-J5 standard steel blades, wheels, tires, Kinner, and OX5 props, OX5 Eagle, Kinner Eagle, Waco 10 parts. All cheap for cash or will trade.—J. H. Krantz, Ripley Airport, North East, Pa.

HAVE high speed A-Ford Monoplane. Can use metal lathe, machinery. What have you?—F. E. Keller, Concordia, Kans.

NEW Lincoln Sport biplane with Anzani motor, less prop. $115. Buhl Bull Pup with Szekely 45, flying $300. Irwin Meteorplane, less Henderson motor, needs going over. $65. Photos 10c. Consider car, motorcycle, larger ship or cash.—Glenn Strauss, 818 Lincoln Ave., Toledo, Ohio.

WILL trade Heath Henderson plane. New. Less motor. Excellent condition. Photo if interested. What have you?—Clair Brown, Sarles, N. Dak.

WHAT is offered for rebuilt Mag. converted Lawrance turns 1750. Okay for flying.—H. L. Lay, Helena, Mont.

WANTED two place light plane, licensed.—John Kimker, Hotel De Soto, Savannah, Ga.

FOR SALE—Aeronca C-2, $350. A1 condition. Less 50 hours total time. Laird OX5, needs tail group and fuselage recovered, $125. Eaglerock OX5, ship needs recovering, $150. Eaglerock OX5 licensed, $225. Automobiles and motorcycles taken in payment, or what have you?—Terry Noll, Pleasant Gap, Pa.

FOR SALE or Trade for Car OX American Eagle byplane $150. Also a Clark Y Wing tail group and landing gears for two place ship.—F. G. Clark, Matfield Green, Kansas.

FOR SALE or Trade a Great Lakes Sport Trainer, Cirrus Mark 3 Motor, 25 hours since major overhaul, good condition. Would like trade for Waco Cabin or Stinson Jr.—Ralph U. Green, 244 S. Beach St., Daytona Beach, Fla.

HEATH PARASOL, pontoons, glider wings, Church Midwing. Will trade for an OX job. Crackups considered. We will also add cash.—Natick Aircraft Club, Natick-Wellesley Airport, Natick, Mass.

LACK OF STORAGE forces sale. One Heath Parasol complete with new prop, wheels, tires, tubes and a good engine. Must have $75.00 or will swap for a boat of equal value. Will deliver up to 100 miles.—William V. Dwarisky, 24A Glendale Ave., Somerville, Mass.

PIETENPOL AIR-Camper, with all parts for converting Ford engine. Will trade for a lightcar.—H. G. Harper, Carthage, Mo.

SUPER-HEATH PARASOL, less motor. Wings and tail surfaces just recovered. Want good motorcycle or what have you?—Stanley B. Morgan, R. F. D. 4, Eaton Rapids, Mich.

TRAVEL AIR NO. 2000, for sale or trade. New OX-5 engine. Ship in perfect condition. Will demonstrate. Call or write.—N. Shelby, 6058 Hamilton Ave., Cincinnati, Ohio. (Kirby 4600)

HEATH-HENDERSON PARASOL, split landing-gear and struts. In flying condition. Will trade for a good welding outfit or what have you?—Donald Seither, 8805 Jeffries Ave., Cleveland, Ohio.

LINCOLN SPORTPLANE, uncovered. Longster fuselage. I want saxophone, motorcycle or welding outfit.—K. L. Swigart, Windham, Ohio.

NEW PIETENPOL complete. Will trade for a one or 2-place licensable plane. Will consider a slight crackup or trade for a late car. Cash $175.00.—George J. Krige, Saratoga, Iowa.

WANTED—Good used light plane. Must be in good condition. Prefer licensed ship. Advise complete details. Will trade late model automobile or pay cash.—J. D. Wise, Hazelhurst, Miss.

FOR SALE or Trade—well equipped and stocked repair shop in city 11,000. Money maker if well handled. Want 2 place aircool licensed plane and some cash.—Box 2, c/o Popular Aviation.

HAVE 2 16x7x4 airwheels with hubs and 2 Szekely pistons and rings (used). Can use Salmson AD9 engine.—Box 395, Fond du Lac, Wis.

FOR SALE or trade, for a good car. A Henderson engine, prop, wing ribs, tail assembly, landing gear (without wheels).—Robert Tait, Indiana, Penn.

WANTED—A pair of pontoons for lightplane. Send complete description.—R. H. Washburn, Owego, N. Y.

ENGINES AND ACCESSORIES

NEW engine with magneto, suitable for Sky Scout or similar light plane. Trade for Harley single motorcycle in good condition.—Ward Hile, Pleasant Gap, Penn.

AIRWHEEL tires 7.005 and 5.004. High Pressure Tires 26x4. and 20x4. 14x3. And Tubes. Trade for Flyers Supplies. — Box 30 Schertz, Texas.

WANTED—1 or 2 cylinder motorcycle engine or converted Laurence for radio parts, 10 in. dynamic speaker, 10 new radio tubes, excellent crystal set, B eliminator, banjo-uke, 25 aero magazines, 45 in. propeller.—Hyman Morris, 1316 S. Troy, Chicago, Ill.

SELL OR TRADE: OX-5 motor, very fine, turns 1400 on ground. Want portable typewriter, firearms, cash or what have you? Write: Chas. L. Anderson, Weedsport, N. Y. (2A).

HAVE 60 H.P. 6 cylinder radial Anzani motor. Want approved serviceable Irvin parachute.—John R. Dowalo, 144 Thompson Ave., Donora, Pa.

WANT Szekely, Aeronca, Continental or similar motor. Have Henderson conversion with two props and cash.—Goodwin Carlson, Garvin, Minn.

HAVE another Smith motor to trade for small wheels and tires, 20x2 preferred but will consider others. Will trade two cylinders opposed motor with four foot prop for a late model single cylinder motorcycle.—R. Manka, 301 South 2nd, Lamar, Colo.

GLIDERS

FOR SALE OR EXCHANGE—Mead Glider in good condition for late model motorcycle.—Paul Willauer, R. D. 3, Quakertown, Pa.

WILL trade Alexander Glider (factory built) for late model motorcycle, Model "A" or Chevrolet.—Ambrose Kaupen, Slayton, Minn.

WILL TRADE government identified 37 ft. span secondary monoplane glider for a cracked Travel Air J-6-150-R540 with right upper and lower wing, landing gear, engine and fuselage intact. What have you?—Francis Ryan, 127 Parkwood Ave., Kenmore, N. Y.

WILL TRADE factory build Eaglerock glider for an Austin car.——Ambrose Kanpen, Slayton, Minn.

MISCELLANEOUS

WANTED—English Riding Boots, size 10½. What do you want?—Orville Bolstad, Northwood, N. Dak.

YOUNG man 20 will fly or work 2 years at $30 per month and board for anyone who will finance me through a commercial aviation course. Please write—Cecil Linscott, Box 175, Oroville, Washington. References.

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AVIATION COURSE to swap. What am I offered?—Copeland, 2298 Priscilla, St. Paul, Minn.

TRADE OR SELL. Improved 80 acres. Located in southeast Nebraska. 50 acres under cultivation. Good buildings, good water and handy landing field. Would prefer part cash in trade. What have you?—Richard Jun, Dubois, Nebr.

WILL TRADE two vacant lots in Beloit, Wis., for airplane.—Box 395, Fond du Lac, Wis.

TO TRADE. Airplane photos for other airplane photos. State full list of photos first time.—Eugene Smih, 1233 N. River Blvd., Wichita, Kansas.

PRINTING PRESS wanted. Used. 3"x5" or 5"x8" size. Have twin opposed bike motor, Maytag motor or cash.—F. Shipps, So. River Road, Zanesville, Ohio.

HAVE ENCYCLOPEDIA, formula for making soft drinks, water-pump, etc. Will trade for lightplane, accordion, tools, or what have you?—Elmer R. Eyster, R. D. 2, Thomasville, Penn.

WILL TRADE. $35 worth of Peerless and Lindberg kits and supplies for a canoe, rowboat or outboard motor.—James Schuler, 936 Portage Trail, Cuyahoga Falls, Ohio.

HEATH-HENDERSON ENGINE, Prop and Tachometer. Will trade for a finished Harlequin crankshaft and crankcase or for an outboard motor, 5 h.p. or more.—F. M. Sears, Seneca, Nebr.

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10 detailed construction drawings.....$ 5.00
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One place; Span, 20', Length, 15'6"; Height, 5'9"; Speed, 120; Lands at 40; Wood or steel fuselage. **WELDED STEEL PARTS:** Fuselage, $75; Tail, $30; Stif leg landing gear, $25; wheel pants, $20.

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For quick service, order from this ad, cash with order

4' for Harley and Indian motors..... $ 4.50
4' 6" Heath-Henderson, metal tipped..... 8.50
6' Fords, Lawrence, Anzani, metal tipped..... 9.98
8' for O.X. 5, hardwood, copper tipped..... 19.95

These propellers are the most efficient made, regardless of name, make, or price. Aeronca Type 40 H.P. motor, $98.00, including prop. New production ships, $98.00. Photos, information including leather bound flying manual, 25c. HIBBS, FT. WORTH, TEXAS

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Look for them on the Special Racers and see why the pilots specify LORENZEN PROPELLERS. You too can have the best and enjoy the difference at no extra cost.

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China

(*Continued from page* 152)

and bomb rack installations, bombs, pilot, fuel, etc., the following speeds and climb were obtained—

PERFORMANCE

Max. speed @ 1000 ft.	128.7 m.p.h.
Cruising speed @ 1000 ft.	104.6 m.p.h.
Landing speed @ 1000 ft.	45.6 m.p.h.
Climb in one minute	1050 ft.
Climb in two minutes	2000 ft.
Service ceiling	18000 ft.

A total disposable load of 972 pounds is adopted which can be the usual passenger and baggage load or an armament load at will. With the equipment provided for the Chinese Government, the military load is itemized as follows.

ITEMIZED ARMAMENT LOAD

Gun and bomb-rack	123 lbs.
Ammunition, 1500 rounds	95 lbs.
Bombs (five 25 lb.)	125 lbs.
Baggage	33 lbs.
Pilot	170 lbs.
Fuel, 63 gals.	278 lbs.
Oil, 6.3 gals.	48 lbs.
Total	972 lbs.

Both the bomb and gun installations are mounted in the exact emplacement of the two-passengers which they displace. This being approximately the center of gravity, the equilibrium of the plane is undisturbed.

A Type A-3 U. S. Army Air Corps bomb gear of the selective type will accommodate alternate loads of five 25-pound Cooper (or other fragmentation bombs) or two 100-pound demolition bombs. There is also a U. S. Army Air Corps type B-3, "safe-and-armed" control which permits the bombs to be dropped without exploding on contact.

END

Direction Finder

(*Continued from page* 162)

are represented by A and B, the indicator turning to the right when A is produced and to the left for B.

If a radio signal comes in from direction a, the field patterns are equal, and "on course" will register; if from direction b the reading is to the right of "on course" since A is greater than B. In like manner, a wave from direction a_1 will show "on course," while one from b_1 will register left of "on course," or a reverse reading from that of direction b.

From this the following rule is evolved: When heading toward the source of the signal the indicator deflects in the direction the loop-antenna is "off course," directive "sense" is assured.

Indication sensitivity, which varies with volume, may be readily increased or decreased by a change in circuit constants, and full-scale deflection of the indicator for 10 degree variation from "course" is easily obtained.

Tuning error is almost entirely eliminated if the loop-antenna is resonated at or above the frequency of the station on which the bearing is taken. If resonated below, distortion of the field patterns by the reversal of phase of the loop-antenna current is quite likely to result in false indications.

The loop-antenna may be tuned or untuned, provided its resonant frequency is never below that of the station being used, and it may be mounted at a distance from the radio receiver and direction-finder unit. The connecting leads to these instruments, however, must be fixed in position by a web belt or similar agency, and there should be a low ground capacity.

Important things to remember in constructing a direction finder of this order are that the loop-antenna must be symmetrical about its center point with respect to ground, the two rectifier plate circuits should be balanced to insure equal inductance and capacity, and there should be no displacement current or secondary loop antenna effect. The latter may be eliminated by adopting a narrow form of winding for the loop-antenna. It is essential that resistors R_2 and R_3 be matched to about one-half of one per cent.

Type 237 tubes serve as rectifiers, the grids and plates being tied together. But slight effect on the field pattern results from resistance variations of these tubes, but since the output circuit depend on the balancing of currents the rectifiers should be reasonably matched. The equallizing of the rectifiers is completed by R_1. It should be arranged for zero reading of the course indicator when there is no incoming signal.

On an intermittent radio wave the finder functions only when the radio wave is received, right and left manifestations of "course" being signified by a kicking of the indicator right and left from zero, and "on course" signals being steady. There is no harsh jerking of the indicator, changes in direction being indicated smoothly.

During severe static or ignition interference there is but little effect when "on course" signals come in, and when "off course" signals are brought in any change in indication leans toward an "on course" indication.

When the direction finder is working the signals may be clearly understood, a steady tone of low intensity in the radio receiver denoting "on course," an increasing intensity signifying "off course."

END

Airy Chat

(*Continued from page 140*)

rate, I would appreciate any suggestions you may have which would lead to our obtaining this painting, even if only for a short display.

Very truly yours,
H. B. MILLER,
Lieutenant, USN.

This request, of course, was gladly granted, and we suppose by this time that the painting is hanging in the office at Sunnydale, Calif. We very greatly appreciate the compliments paid by Lieutenant Miller who should certainly be an authority on the accuracy of this painting.

* * *

THE Comet National Replica contest has drawn to a close, the winners picked and the prizes awarded. It was a great contest and full of interest. The winning model was a Boeing P4B-4 built by Edward Poremba, Cicero, Ill. Every detail was faithfully reproduced. Alex Horbach, Chicago, Ill., drew the second prize with another model of the same ship. Robert Bosser, Appleton, Wis., won the third prize with a Spad model.

* * *

AT LAST, bureaucratic politics has reached out and attempted to victimize Gen. Benjamin Delahauf Foulois, now Chief of the U. S. Army Air Corps. This is the latest attempt on the integrity of our air-service personnel after repeated raids upon other divisions. They are picking on a very small man (physically) but a man with a very great record of achievement. With an eye cocked for the November elections, they are determined to make Gen. Foulois the goat for the airmail fiasco.

Gen. Foulois has always been an inspiration to everyone interested in military aviation. He was our first military pilot and for some time supported the first army airplane from funds taken out of his own pocket. He begged for an air force while Congress, as usual, laughed at the idea. And now they are condemning him after carrying on under almost unsupportable conditions. We quote a sentence from his testimony to the investigating committee that graphically displays his long struggle against the General Staff:

Whom are they trying to fool? You? Me? Or someone else? I am suspicious. As I say, I fought them for twenty years, and I think that they are trying to fool me and trying to fool you.

But we have confidence that the doughty general will lick his accusers, even strong as they are politically. And, we are just an even 100 percent. for Benny Foulois and his achievements.

* * *

PROF. F. K. KIRSTEN, University of Washington, has recently demonstrated a full-size paddle-wheel ship at Stanford University, Palo Alto, Calif. It is expected that this will be the forerunner of a whole flock of similar ships in this country.

We hope to get more details on the construction of this ship than have yet been made public to date for it is more than a passing novelty—it really marks a new era in flight.

* * *

READERS will please notice that it has been found necessary to advance the price of notices in the Barter and Exchange Department to 3 cents per word. The rate was formerly 2 cents per word.

* * *

ACCORDING to the *Aeroplane*, the performance of the Hawker Fury has again been increased by the substitution of a Rolls-Royce "Goshawk" engine and by numerous minor alterations. We wonder what her "top" is now?

* * *

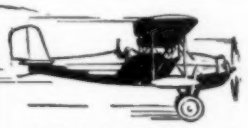
JUST as a big favor to us, we will ask our authors and other correspondents asking for a reply, to kindly print their names and addresses. We have a great time deciphering some of the hen-tracks that come into the office and many mistakes are the result. Thank you.

* * *

WELL, we have about caught up with the Lincoln advertisement below, so we'll have to sign off. Here's to you and wishing you well on your summer vacation.

J. B. R.

for Success in AVIATION



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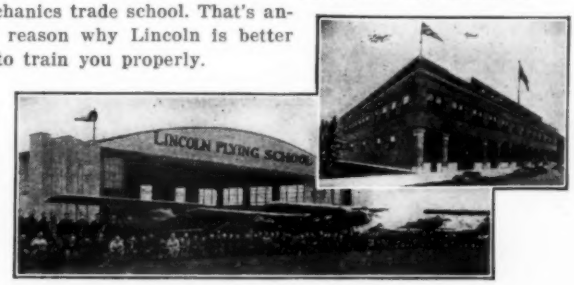
14 Years Teaching Aviation— That's the outstanding record of LINCOLN. GOVERNMENT APPROVED SCHOOL. Also backed by 24 years' successful experience as a mechanics trade school. That's another reason why Lincoln is better able to train you properly.



The Lincoln Flying school and mechanic school shown to the right are among the finest in America. Come join these men who will reap big pay success in Aviation's future. **Part time employment** offered to limited number now. Hurry!

The Best in Training Equipment—Only modern high class training planes with Dept. of Commerce approval are used to train you at Lincoln. Highest type pilot instructors. Training for government license as Transport, Limited Commercial, Private or Amateur Pilot. Complete training includes blind flying by instrument, cross country, acrobatics. High wing and low wing monoplanes, biplanes, cabin planes, etc., used to assure you all kinds of experience. Both flight and ground training **under Government Supervision.** Thoroughly equipped ground and mechanics school with high class, experienced instructors qualify you as Master Airplane and Engine Mechanic.

ACT NOW— The Government's present activity and expenditure of millions of dollars to promote aviation means thousands of new jobs. Big pay opportunities also in Central and South America. Lincoln's Aviation courses taught in either English or Spanish. Don't wait. Let Lincoln train you. **Mail this Coupon Now!**

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by Hilton F. Lusk, Transport Pilot; formerly Dean, Boeing School of Aeronautics. 175 illustrations. **$3.25.**

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A PILOT'S TRAINING GUIDE

PRACTICAL FLYING

by Major B. Q. Jones, Air Corps, U. S. Army; formerly Chief of Aviation Training A.E.F. **$3.00.**

This famous pilot's manual can save you hours of time and a lot of money in your flying training. Reading this book is like having at your elbow the famous flyer who wrote it, ready to clear up quickly all the scores of questions that puzzle you as you progress to the skill of an expert pilot. It gives you the basic facts that otherwise you would have to learn from long and costly experience. Major Jones provides clear and concise answers to the hundreds of questions that student pilots have asked for years—information that is essential for a proper understanding of piloting. A variety of practical subjects is covered, such as taxying, the take-off, the initial climb, emergency landings after the take-off, straight-away flight, turns, figures-of-eight, glides, landings, cross-country flying, stalls and spins, etc. The book is packed with useful facts on planes, instruments, technical expressions, plane parts, pilot's equipment, methods of plane inspection, testing controls and motor.

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